

Fig. 1

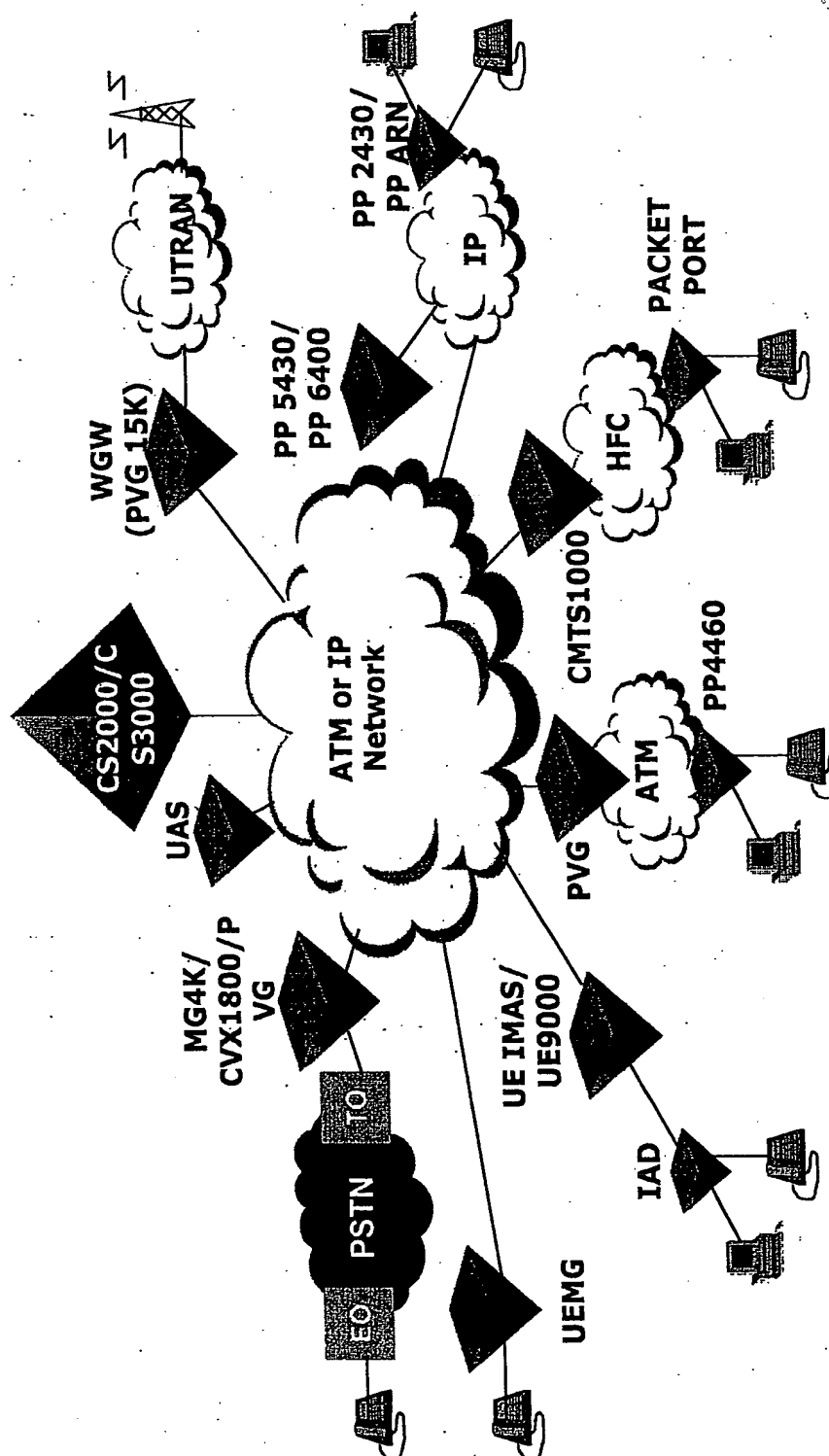


Fig. 2

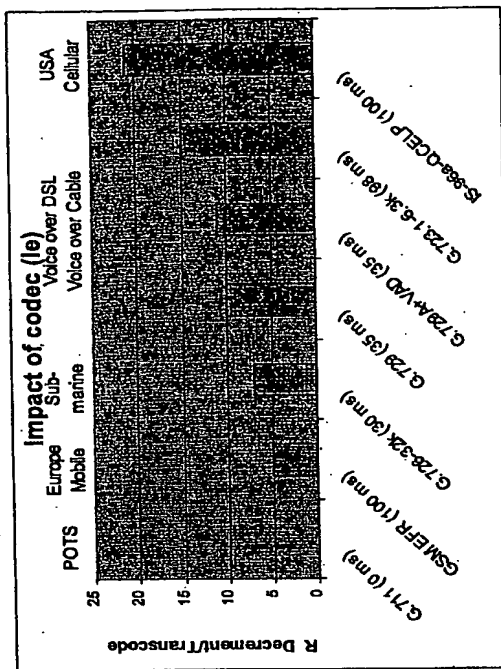
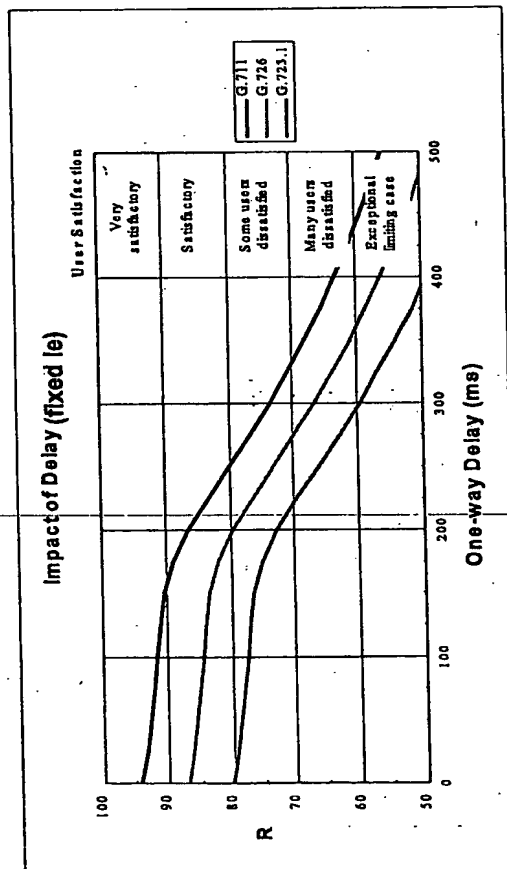


Fig. 3

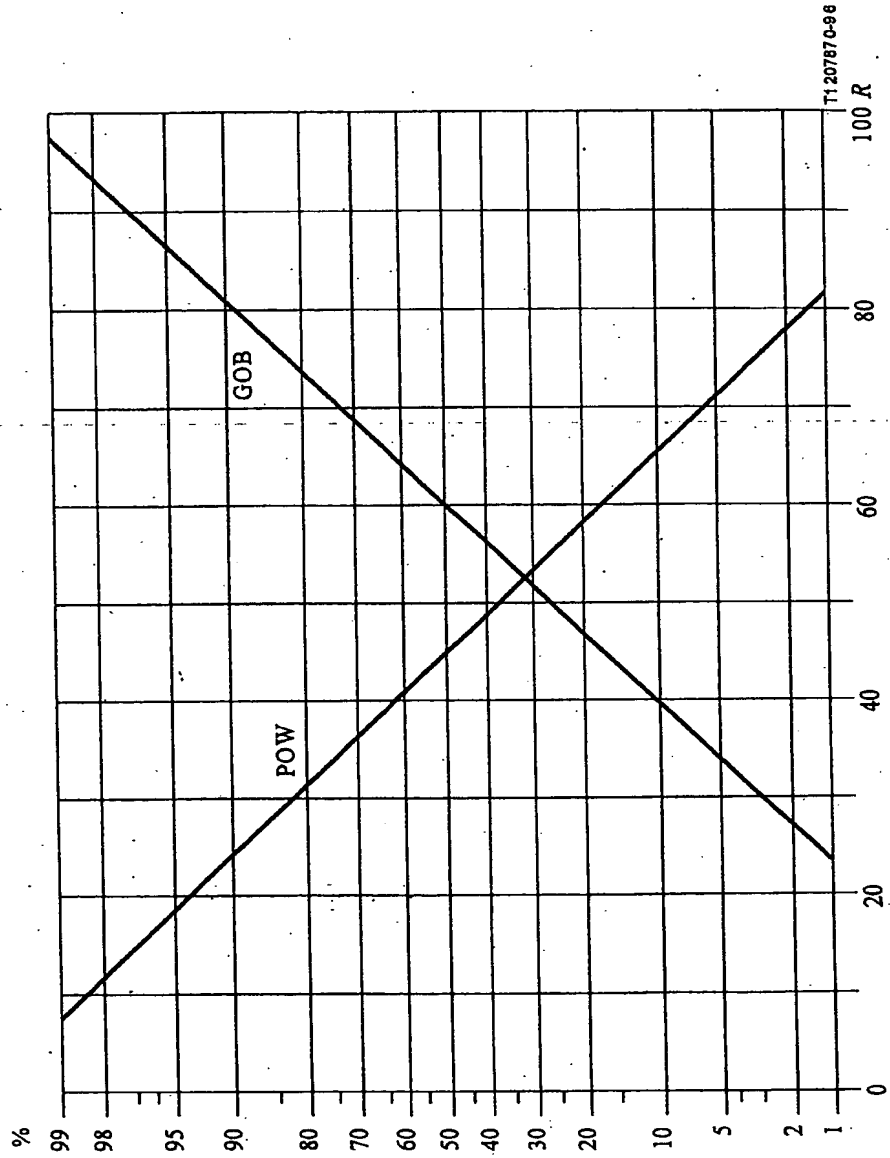


Figure B.1/G.107 - GOB (Good or Better) and POW (Poor or Worse) as functions of rating factor R

Fig. 4



Fig. 5

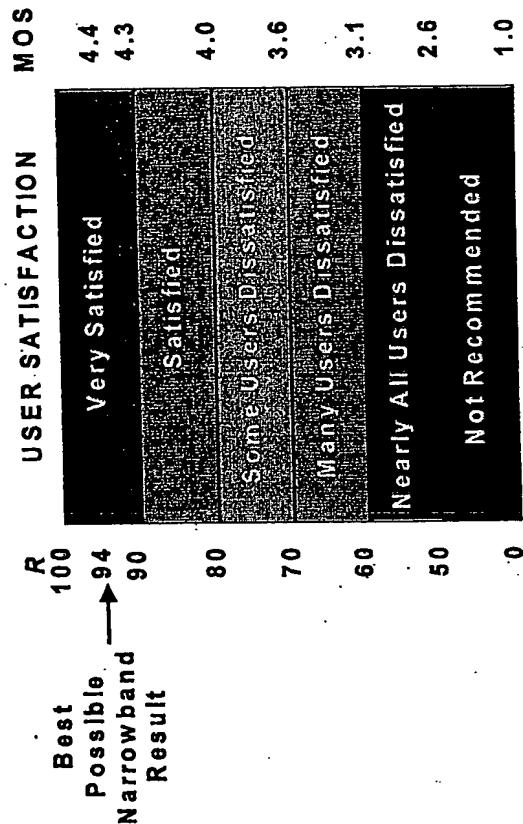


Fig. 6

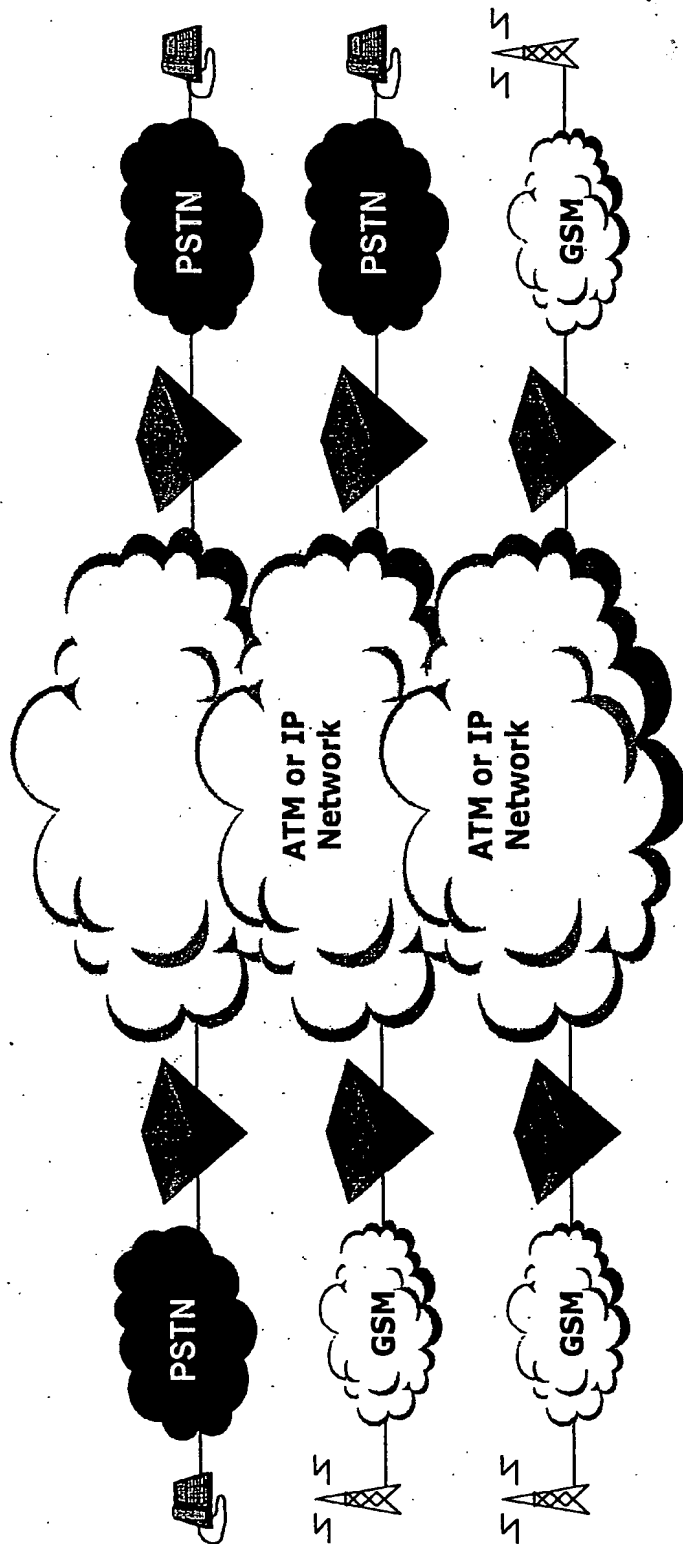
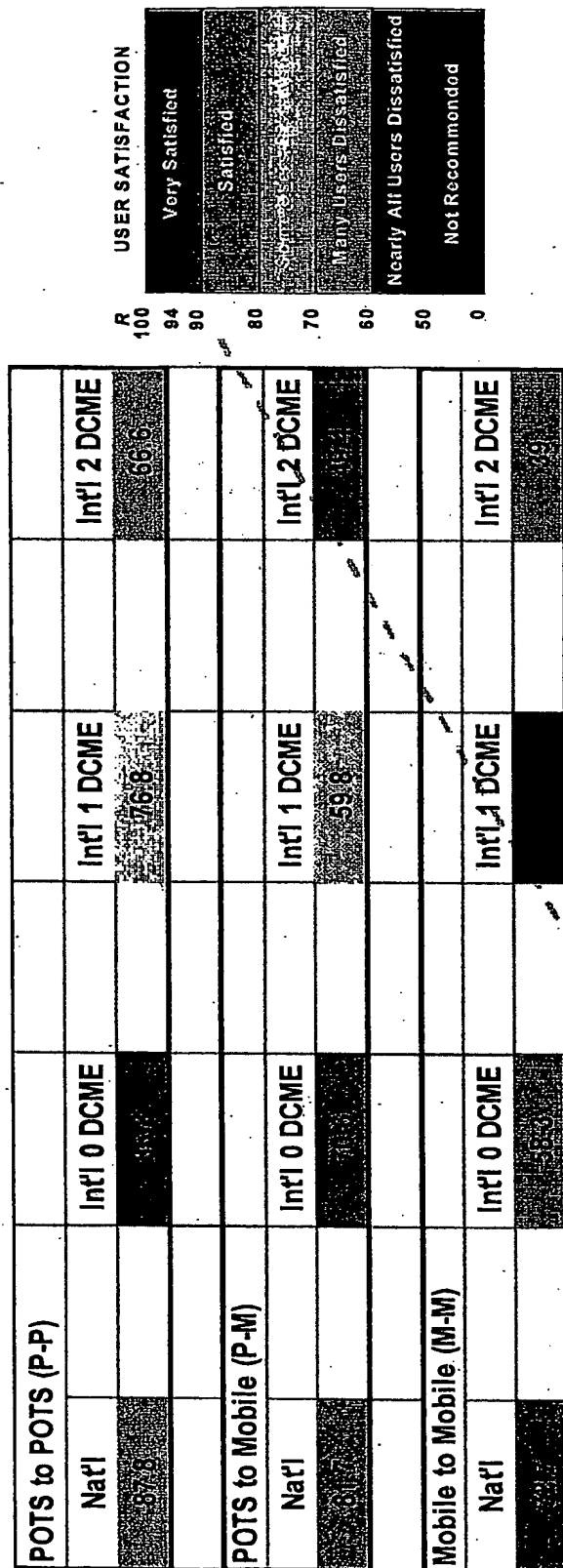


Fig. 7



Mobile is GSM EFR.
POTS is modelled for an analogue set.
Nat'l = 8000km, Int'l = 27500km.

Limit of acceptability - a hard threshold

Fig. 8

What reference calls will be the most demanding quality measure?

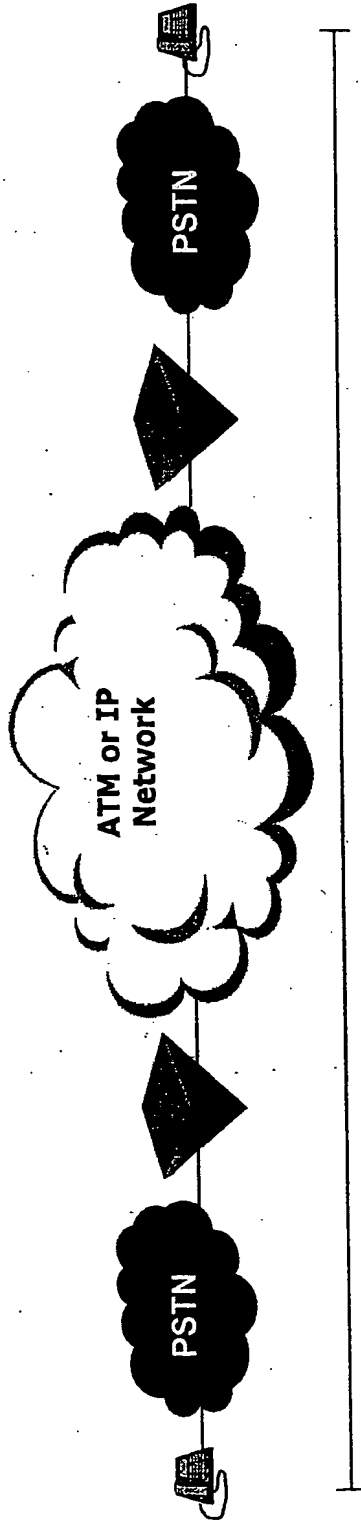


Fig. 9

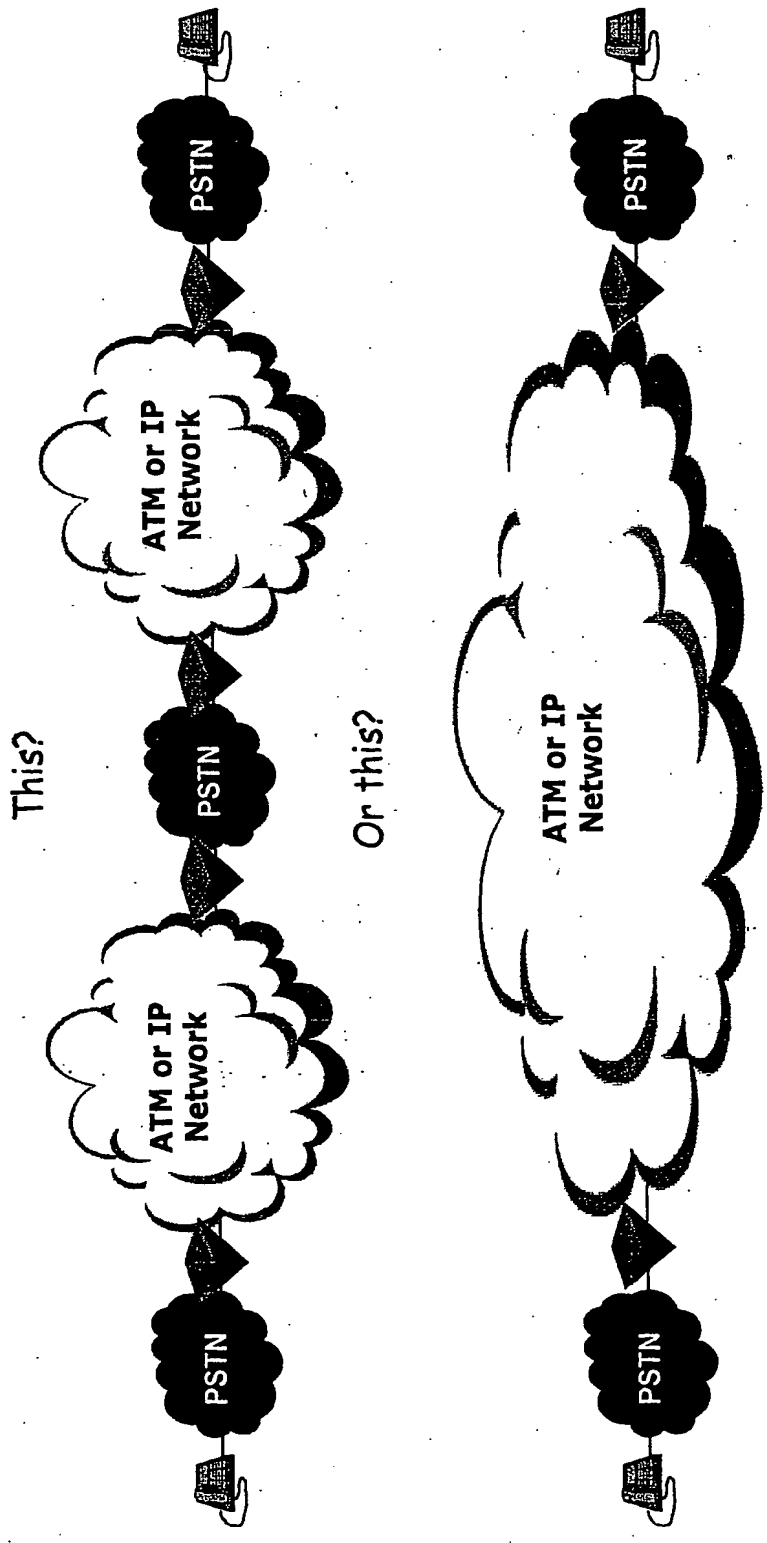
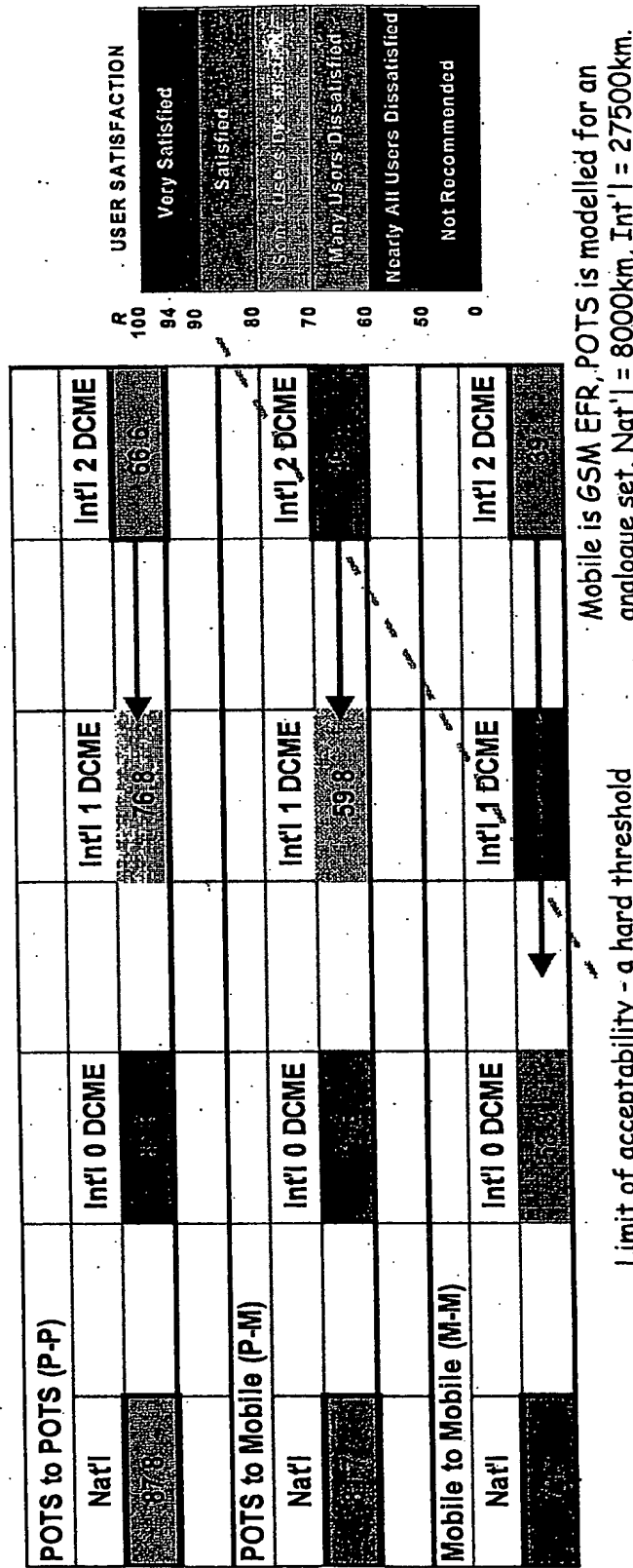
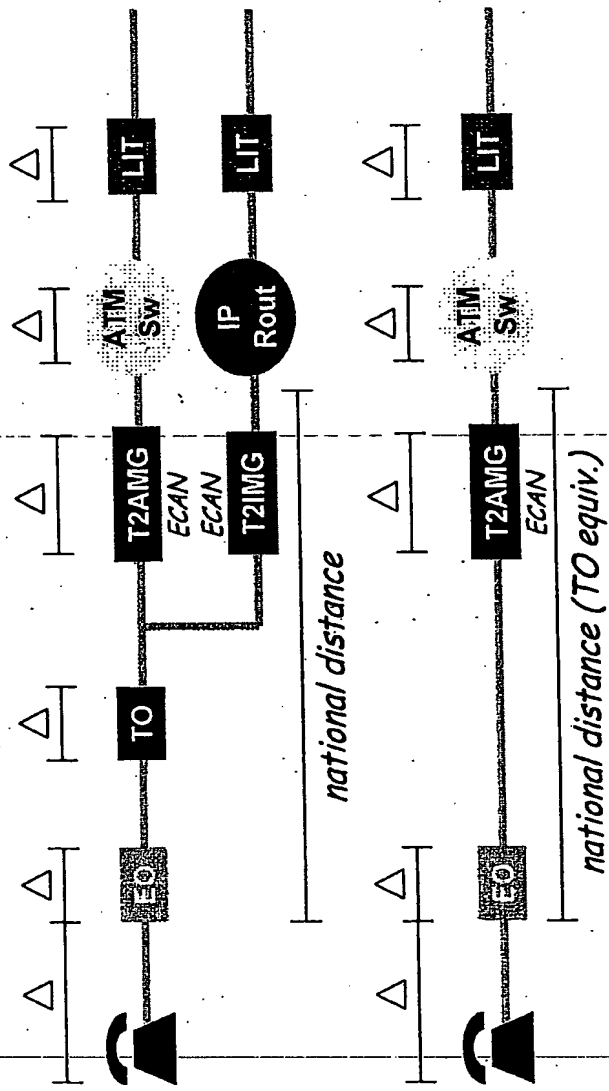


Fig. 10



(*5R = 0.2 MOS over most of the linear range considered in the statistical noise by many practitioners.)

Fig. 13



1. The first step is to identify the network topology. This is done by identifying the nodes and the links between them. The nodes are represented by the letters A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z. The links are represented by the letters A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z.

Fig. 14

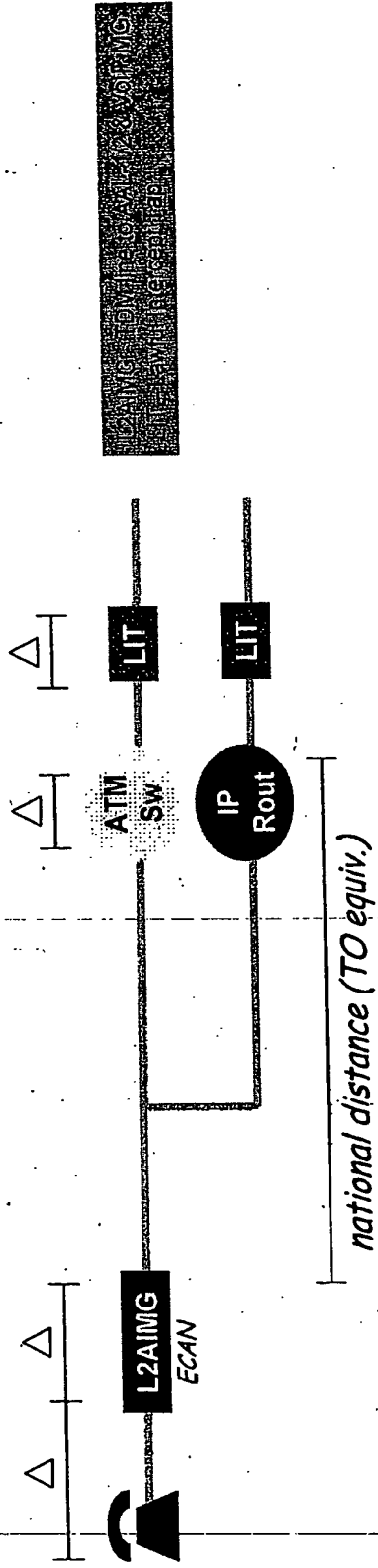


Fig. 17

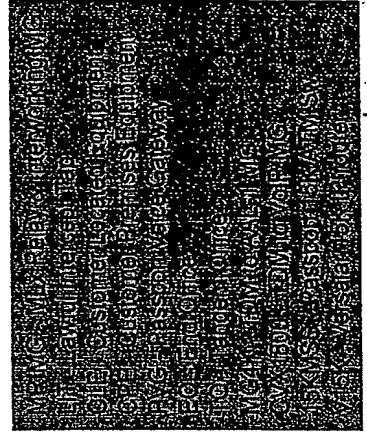
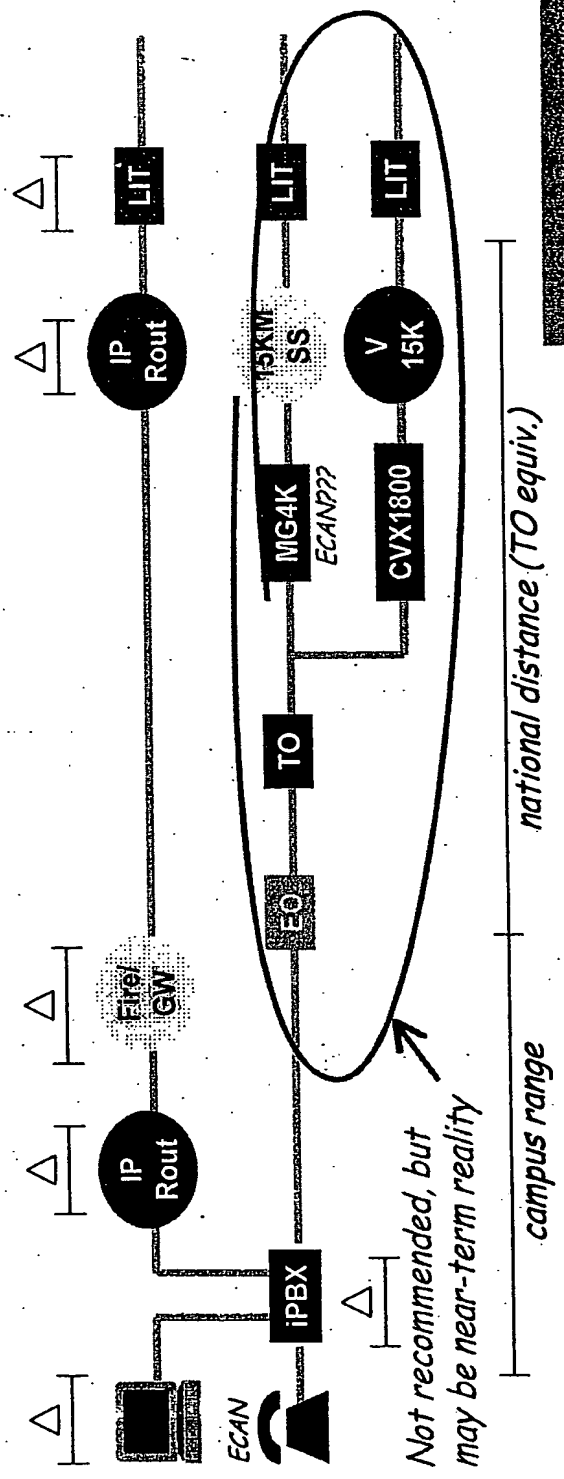
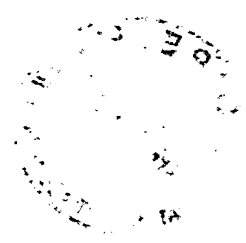
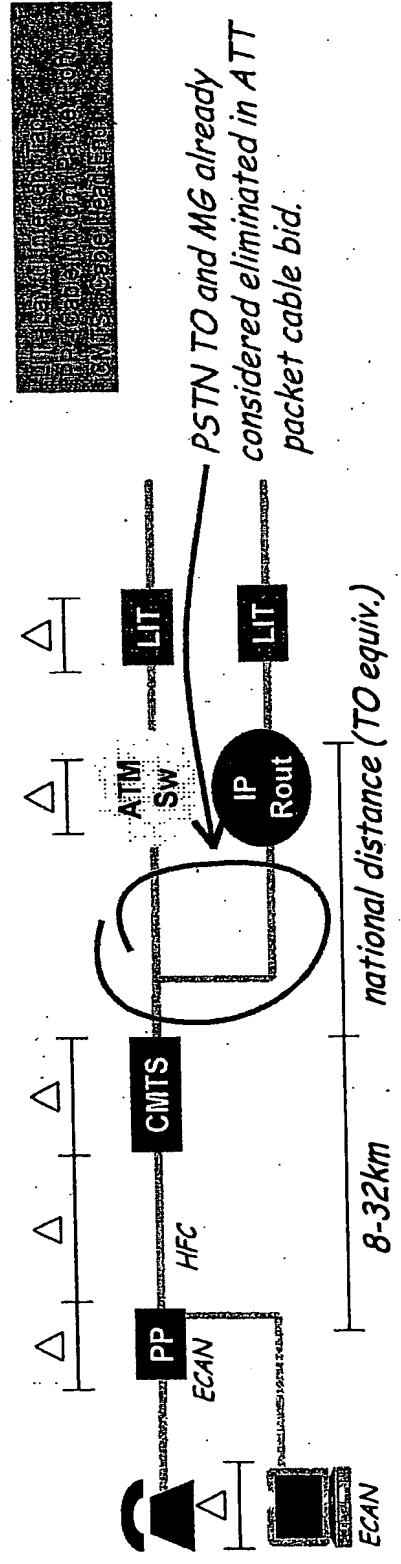


Fig. 18



27,500km - 2*(distance from subs to TO equiv.)

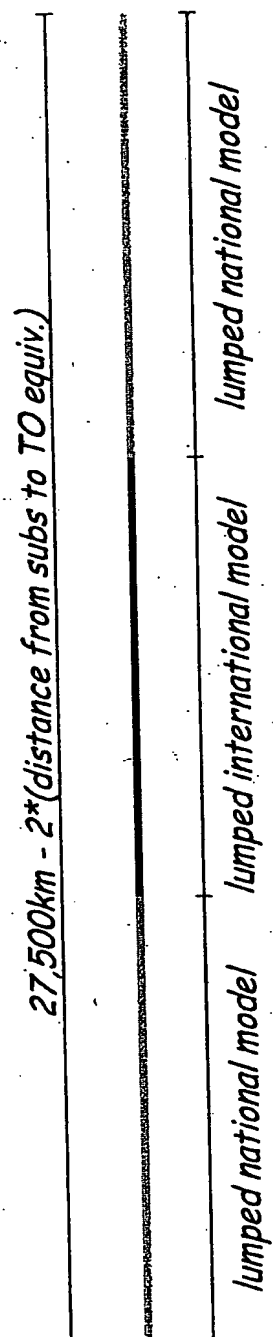


Fig. 22

E-Model Parameter Default Values

Parameter	Units	Value
SLR (Send Loudness Rating)	dB	8
RLR (Receive Loudness Rating)	dB	2
STM (Sidetone Masking Rating)	dB	15
LSTR (Listener Sidetone Rating)	dB	18
OLR (Overall Loudness Rating)	dB	10
TELR (Talker Echo Loudness Rating)	dB	65
WEPL (Weighted Echo Path Loss)	dB	110
T (Mean Intrinsic One-Way Delay)	msec	0
Ta (Absolute Delay)	msec	0
Tr (Round-Trip Delay)	msec	0
QDU (Quantization Distortion Units)	-	1
Ie (Equipment Impairment Factor)	-	0
A (Expectation Factor)	-	0
Ds (Handset Shape Factor - Send Side)	-	3
Dr (Handset Shape Factor - Receive Side)	-	3
Ps (Room Noise at the Send side)	dB(A)	35
Pr (Room Noise at the Receive side)	dB(A)	35
Nc (Circuit Noise referred to 0 dBm0p)	dBm0p	-70
Nfor (Noise Floor at the Receive Side)	dBmp	-64

Fig. 24

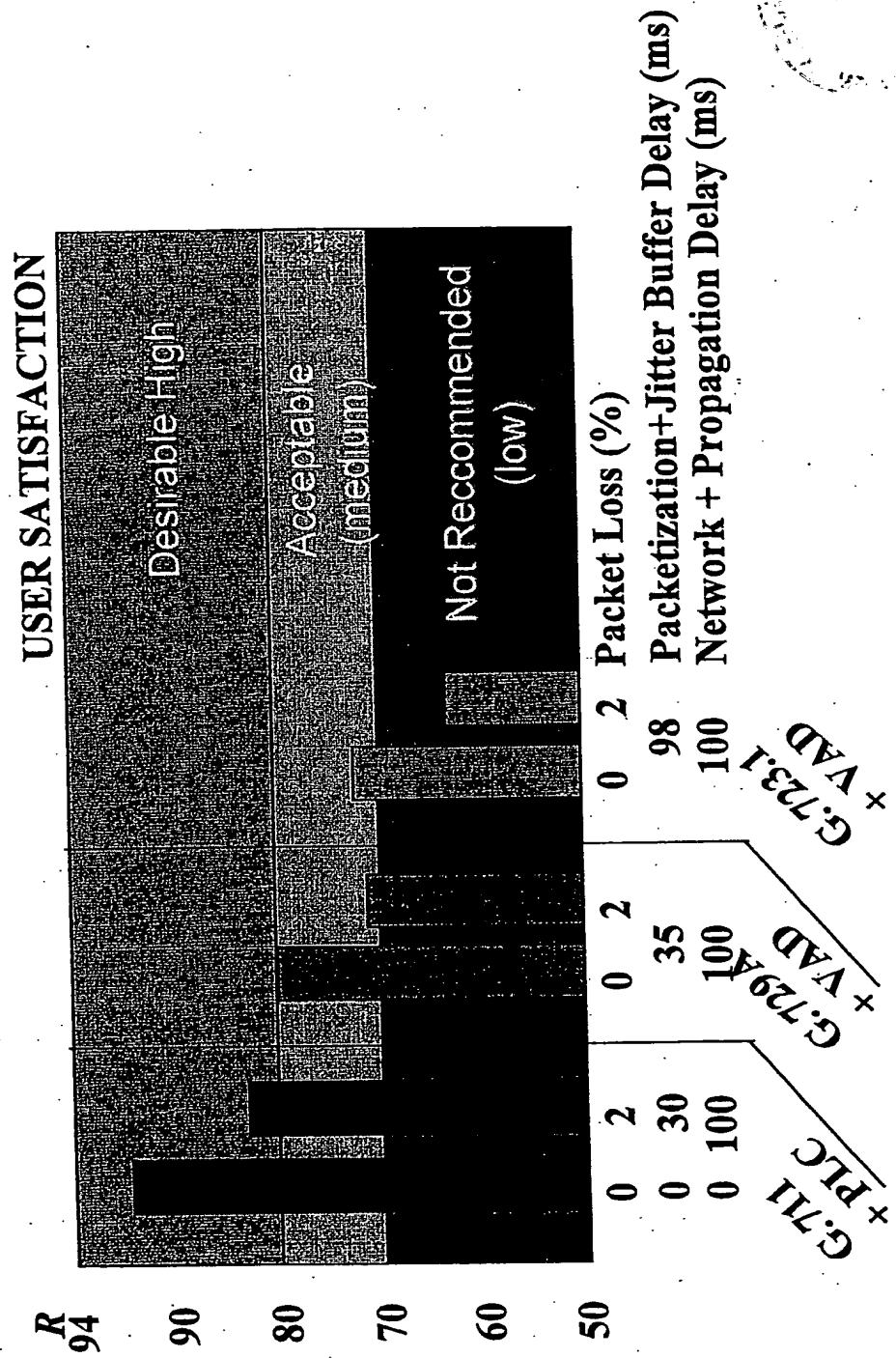


Fig. 25

G.726 Model Calculations											
G.711 [Ratio Noise]	G.711 [Noise]	G.711 [Noise]	G.711 [Noise]	G.711 [Noise]	G.711 [Noise]	G.711 [Noise]	G.711 [Noise]	G.711 [Noise]	G.711 [Noise]	G.711 [Noise]	G.711 [Noise]
10	20	30	40	50	60	70	80	90	100	110	120
0	0	0	0	0	0	0	0	0	0	0	0
1	8	10	13	16	19	22	26	30	32	35	38
2	13	16	19	22	26	30	32	35	38	40	42
3	19	22	26	30	32	35	38	40	42	44	46
4	22	26	30	32	35	38	40	42	44	46	48
5	25	30	32	35	38	40	42	44	46	48	50
Packet Loss (%)											
0	0	0	0	0	0	0	0	0	0	0	0
1	5	10	13	16	19	22	26	30	32	35	38
2	7	13	19	22	26	30	32	35	38	40	42
3	10	19	24	29	33	37	40	42	44	46	48
4	12.5*	22	28	32	36	40	42	44	46	48	50
5	15	25	32	35	38	40	42	44	46	48	50

Notes:

- 1) In the absence of any supporting documentation, these are arbitrary values
- 2) All G.711 vocoders are assumed to have PLC (Packet Loss Concealment) algorithms
- 3) Impairment factors apply for random packet loss conditions
- 4) This is the current capability of the i2004 (in the absence of any download instructions to achieve smaller frame size)
- 5) There is no PLC algorithm for G.726, therefore its deployment might be limited in lossy network
- 6) Interpolated values

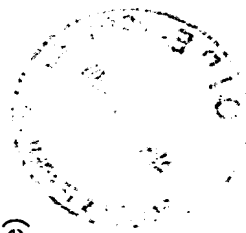


Fig. 27

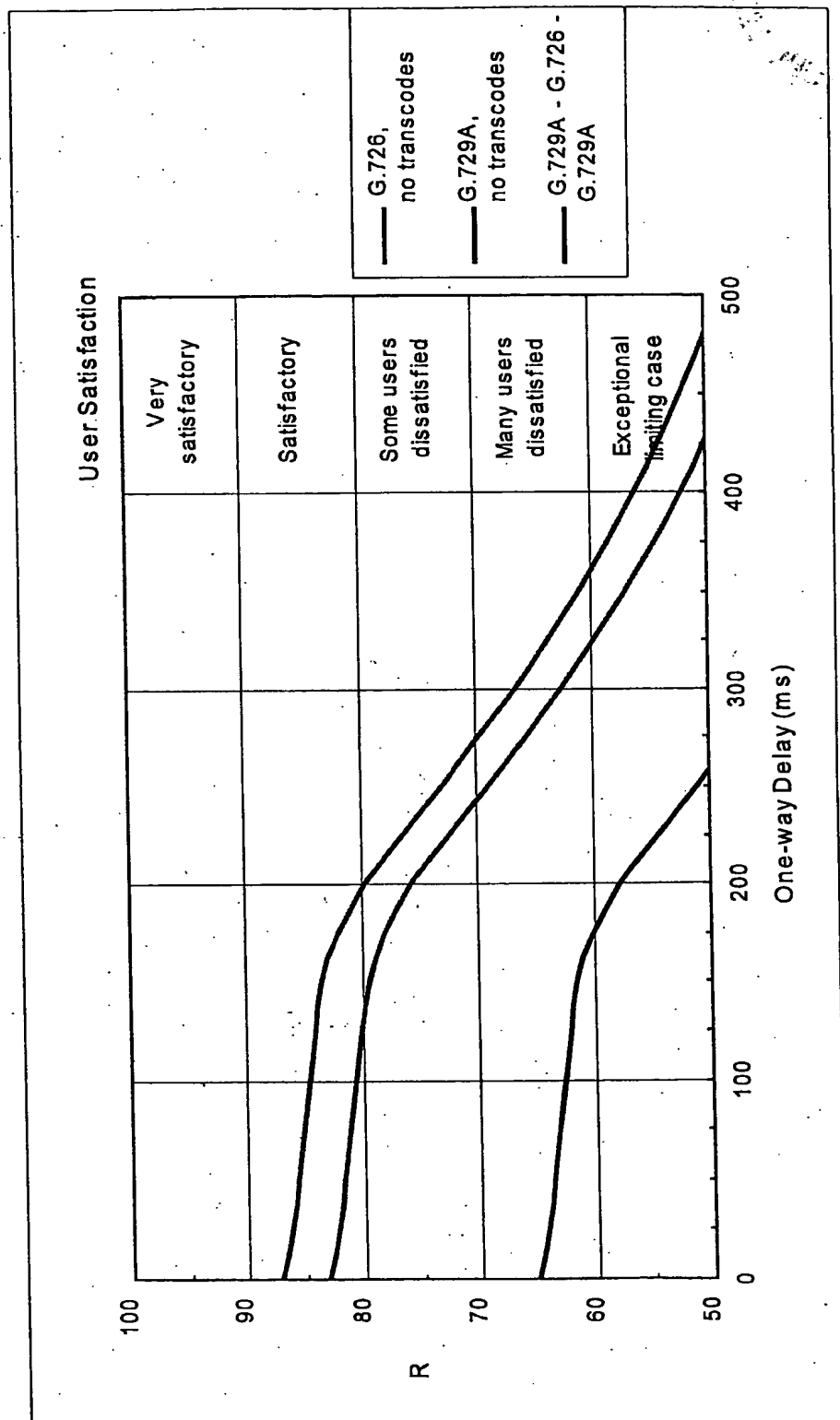
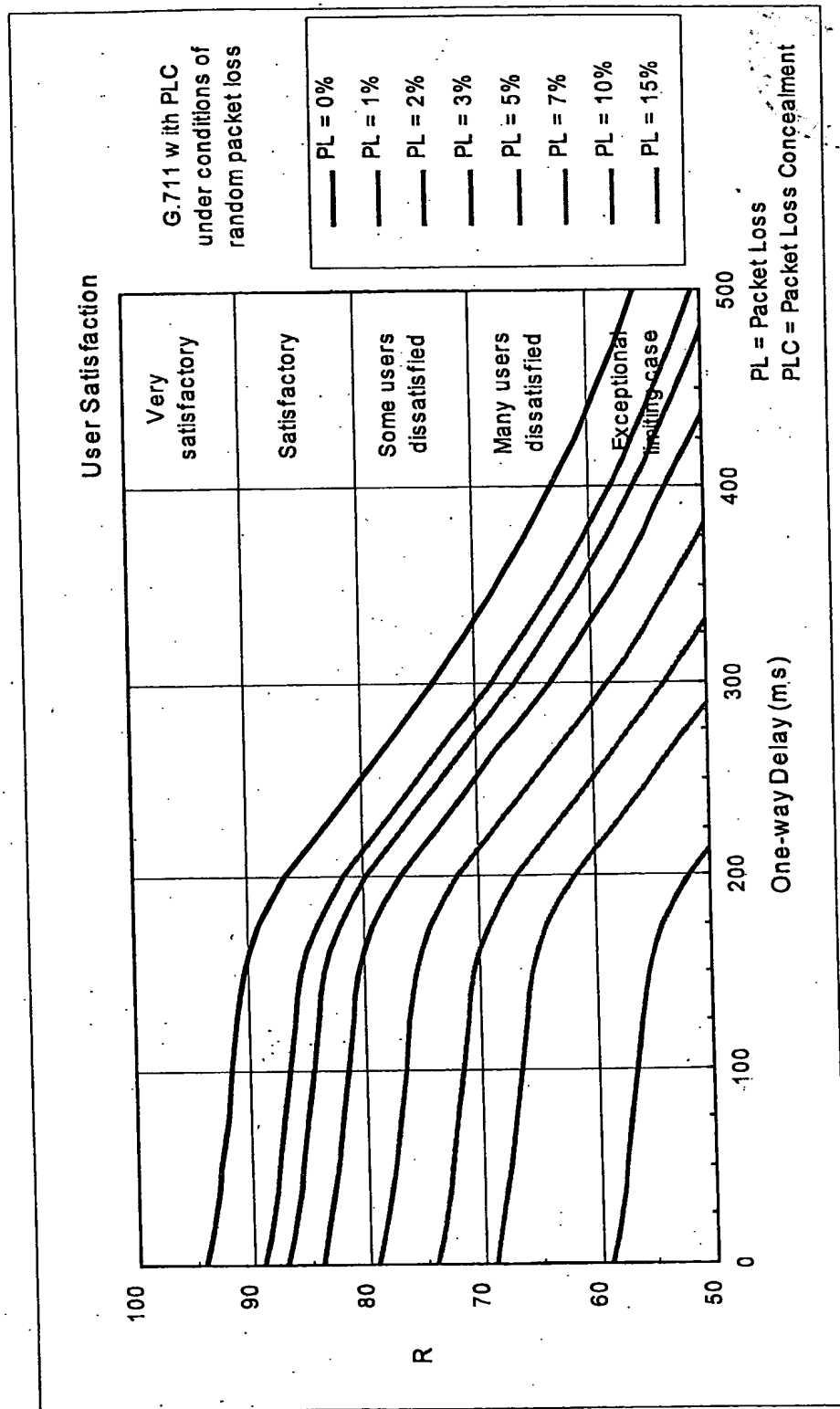


Fig. 28



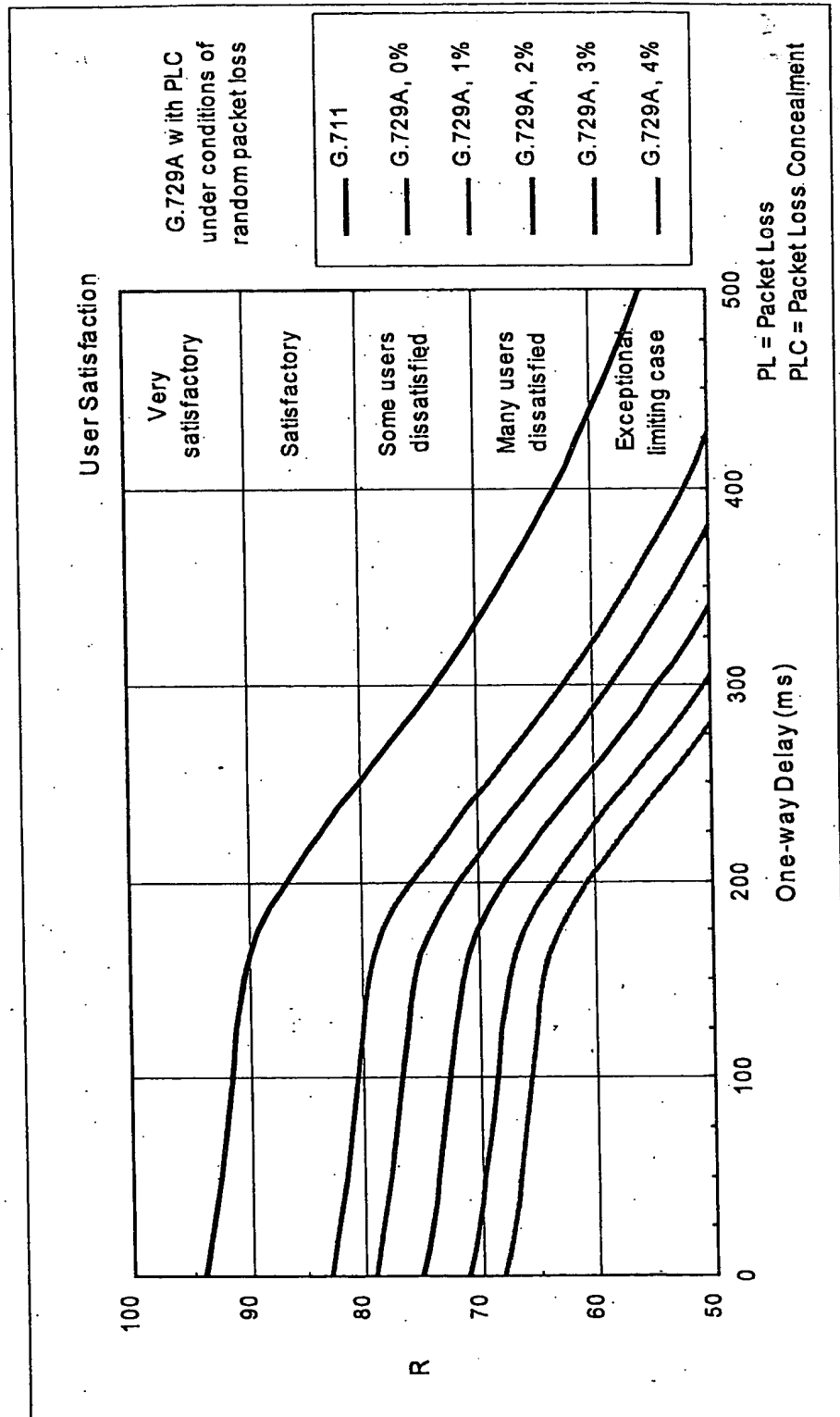


Fig. 30

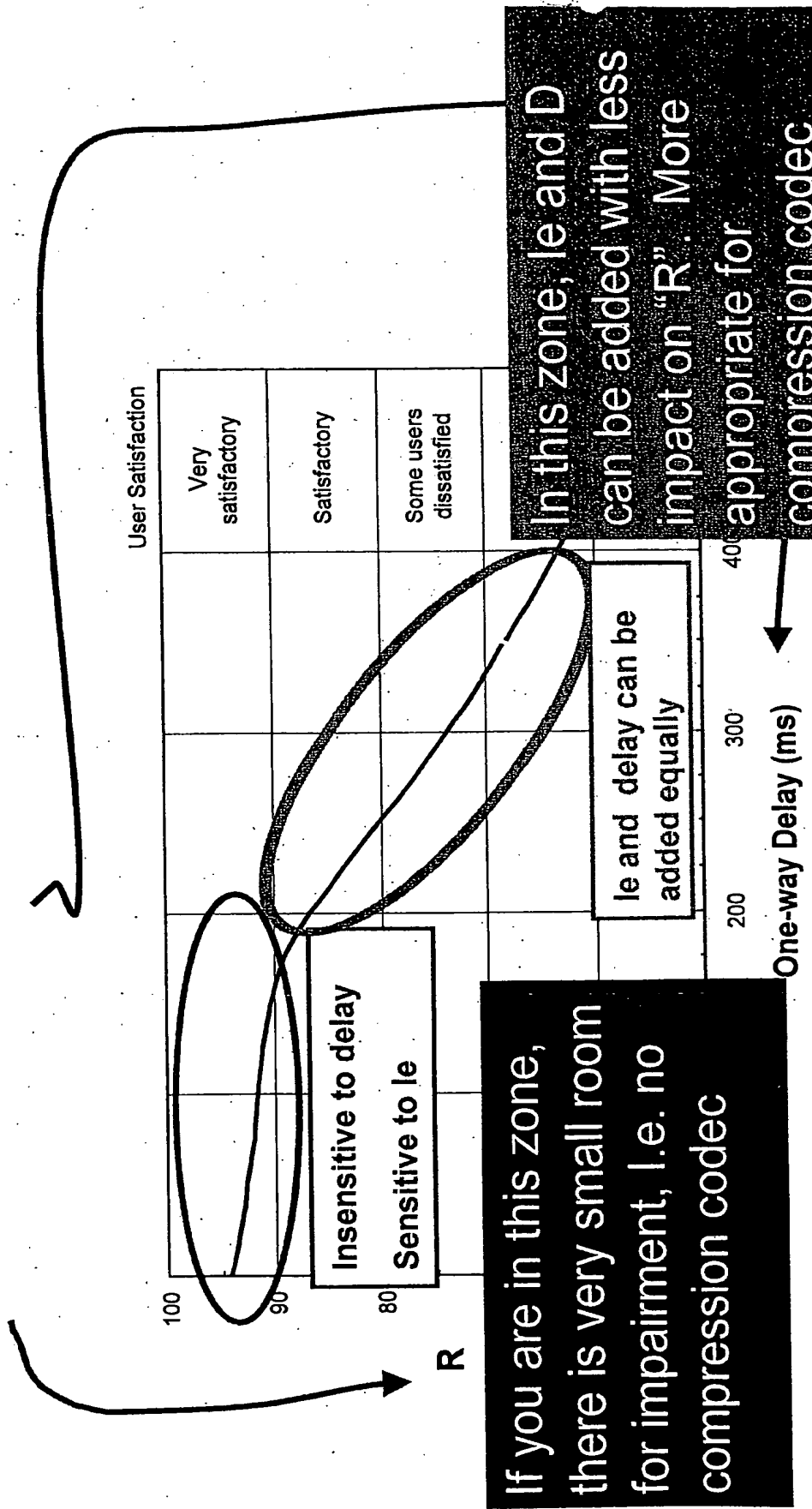


Fig. 31

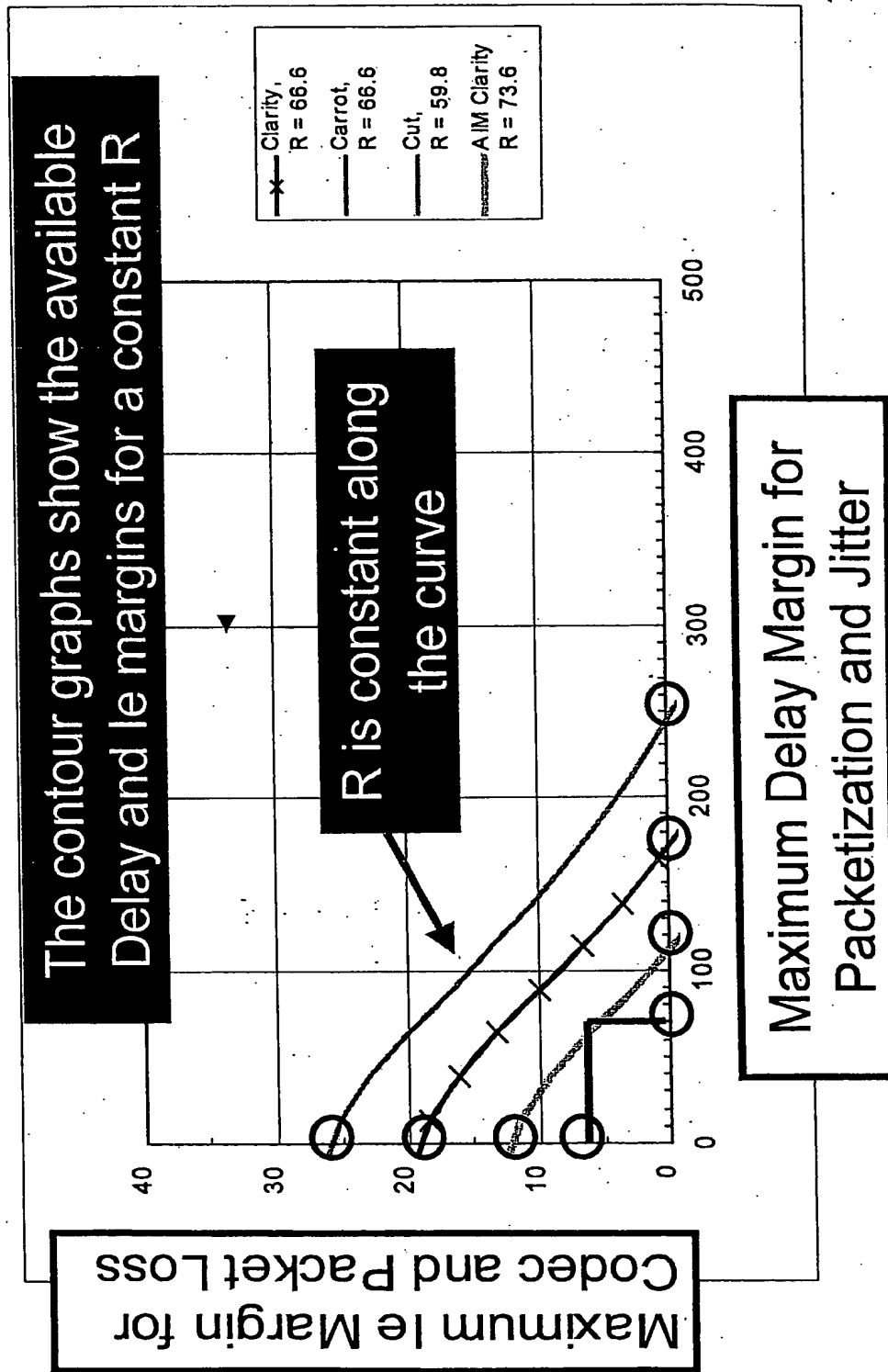


Fig. 32

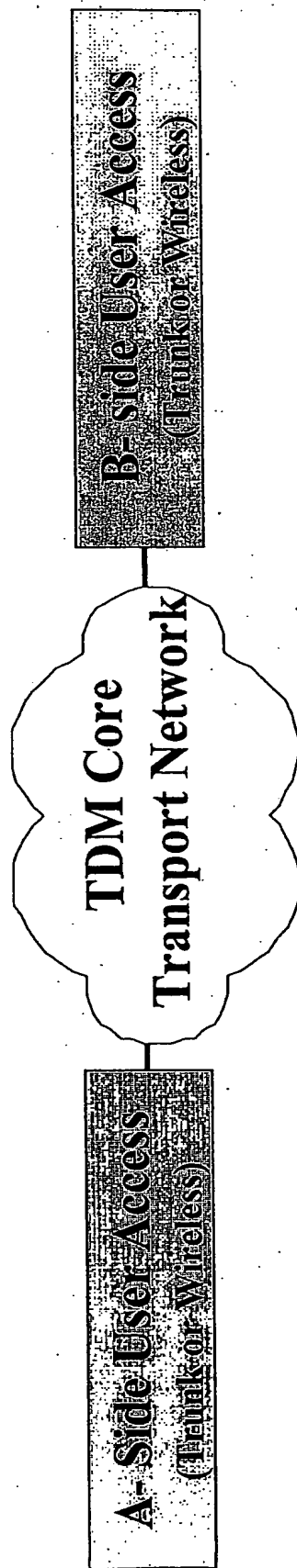
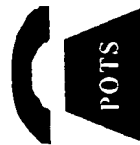
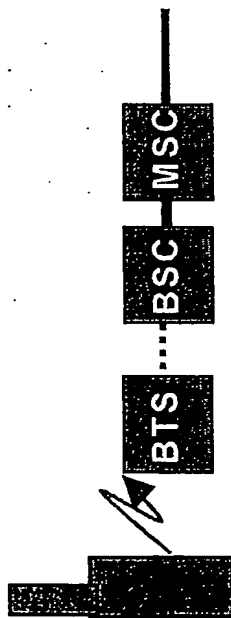


Fig. 33



Parameter	Symbol	Units	Typical Value
Electric Circuit Noise (at 0 dBr)	Nc	(-70 dBmP)	35
Room Noise	Po	(35 dBA)	11
Send Loudness Rating	SLR	(8 dB)	3
Receive Loudness Rating	RLR	(2 dB)	3
D-factor	D	(3)	-64
Noise Floor	Nfor	(-64 dBm0)	15
Sidetone Masking Rating	STM	(15)	0
Equipment Impairment Factor	Ie	(0)	0
Expectation (Advantage) Factor	A	(0)	0
Mean Intrinsic One-Way Delay (upper)	Tu	(0 ms)	0
Mean Intrinsic One-Way Delay (lower)	Tl	(0 ms)	0
Mean Intrinsic One-Way Delay	Tul	(0 ms)	0
Electrical Loss (upper)	Lu	(dB)	0
Electrical Loss (lower)	Ll	(dB)	0
Electrical Loss (upper = lower)	Lul	(dB)	0
Quantizing Distortion Units (upper)	qduu	(1) [Note 1]	0
Quantizing Distortion Units (lower)	qdul	(1) [Note 1]	0
Echo Return Loss	ERL	(dB)	17

Fig. 34



BTS: Base Station
 BSC: Base Station Controller
 MSC: Mobile Switching Center

PSTN/Wireless Access Delay, Loss and Impairment Summary			
	Uplink	Downlink	
Mobile Switching Center (MSC) (ms)	1	2	
Base Station Controller (BSC) (ms)	2.5	40	
Base Station (BTS) (ms)	15.8	40.8	
Mobile Set (MS) (ms)	72.1	14.3	
PSTN Wireless Access Delay (ms)	91.40	97.10	
Impairment Factor (1e)	5	5	

Fig. 35

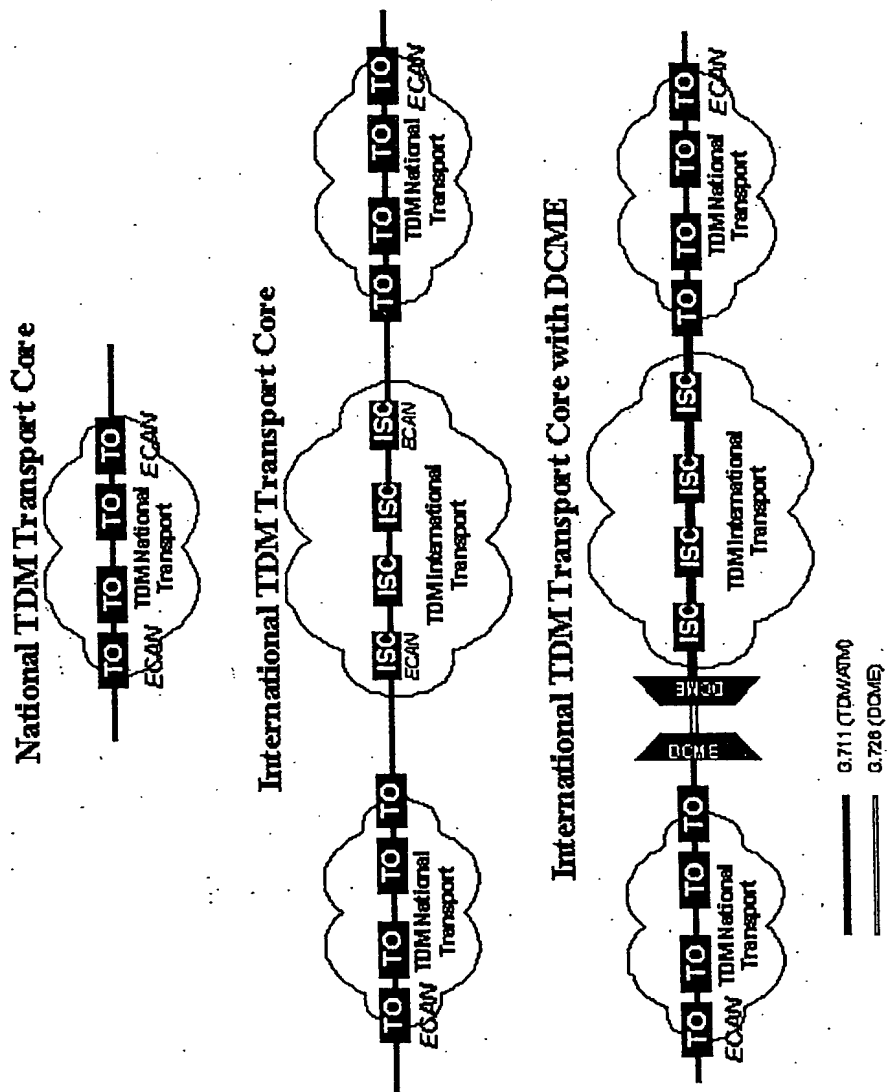


Fig. 36

ITU-T G.807.00	National (8000 km)	International (connection length 27500 km)		
		T2DCME T2DCME	T2DCME T2DCME	T2DCME T2DCME
National Transmission Time	43	43	43	43
T2DCME (G.711/G.726 Conversion+DSI) (ms)	-	0	26	52
DCME2T (G.726/G.711 Conversion) (ms)	-	0	2	4
International Transmission Time (ms)	-	72	72	72
National Transmission Time	-	43	43	43
Total one-way delay (ms)	43	158	186	214
Impairment Factor (le)	0	0	7	14



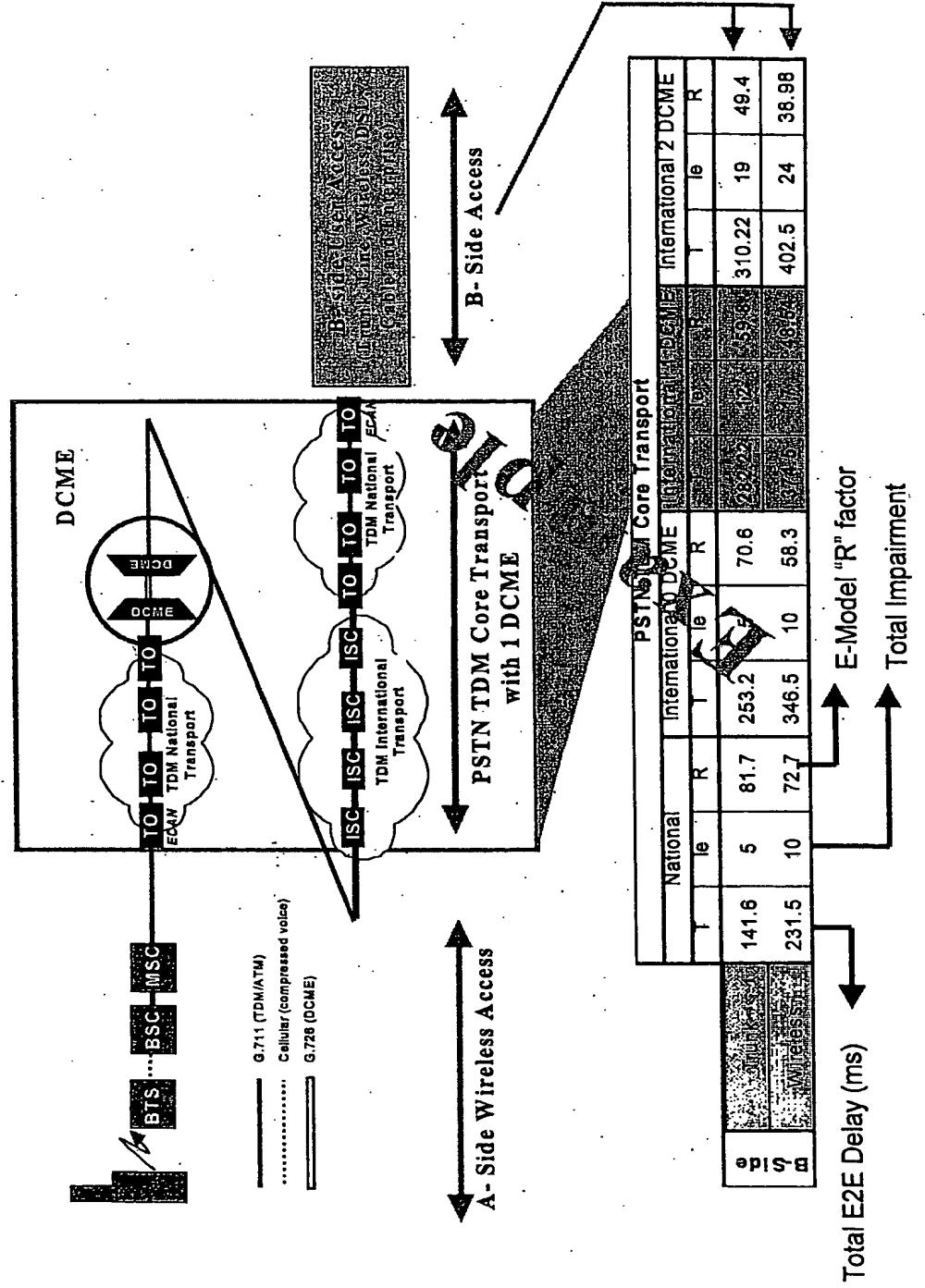
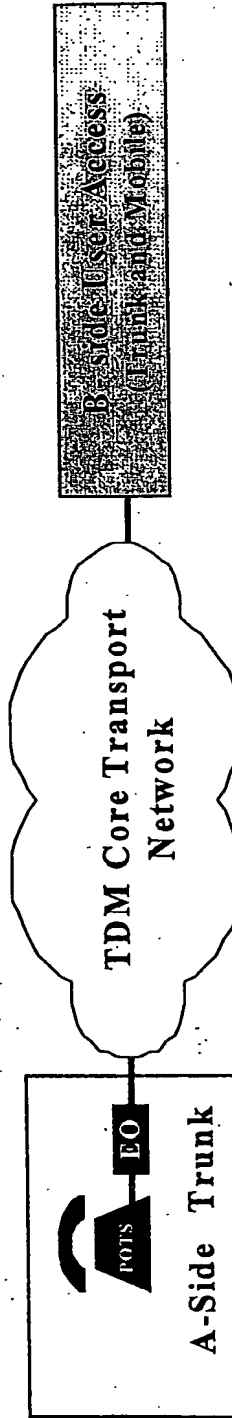


Fig. 38

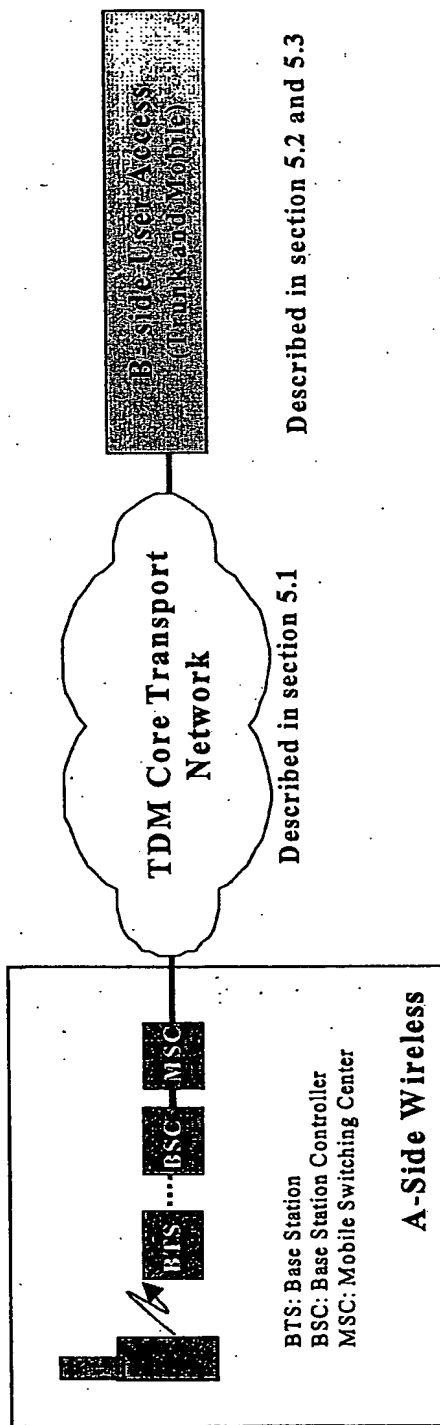


Described in section 5.1

Described in section 5.2 and 5.3

Network Access	National			International CDOVE			International DOVE			International 2 DOVE		
	T	le	R	T	le	R	T	le	R	T	le	R
Unlink	46	0	87.8	161.22	0	85.8	190.22	7	76.8	218.22	14	66.6
Wireless	139.24	5	81.7	253.22	5	70.6	282.22	12	59.8	310.22	19	49.4

Fig. 39



Described in section 5.2 and 5.3

Described in section 5.1

Wireless Access	National			International 1 DCME			International 2 DCME		
	T	le	R	T	le	R	T	le	R
Trunk	141.6	5	81.7	253.2	5	70.6	282.22	12	59.8
Wireless	231.5	10	72.7	346.5	10	58.3	374.5	17	48.54
							402.5	24	38.98

Fig. 40

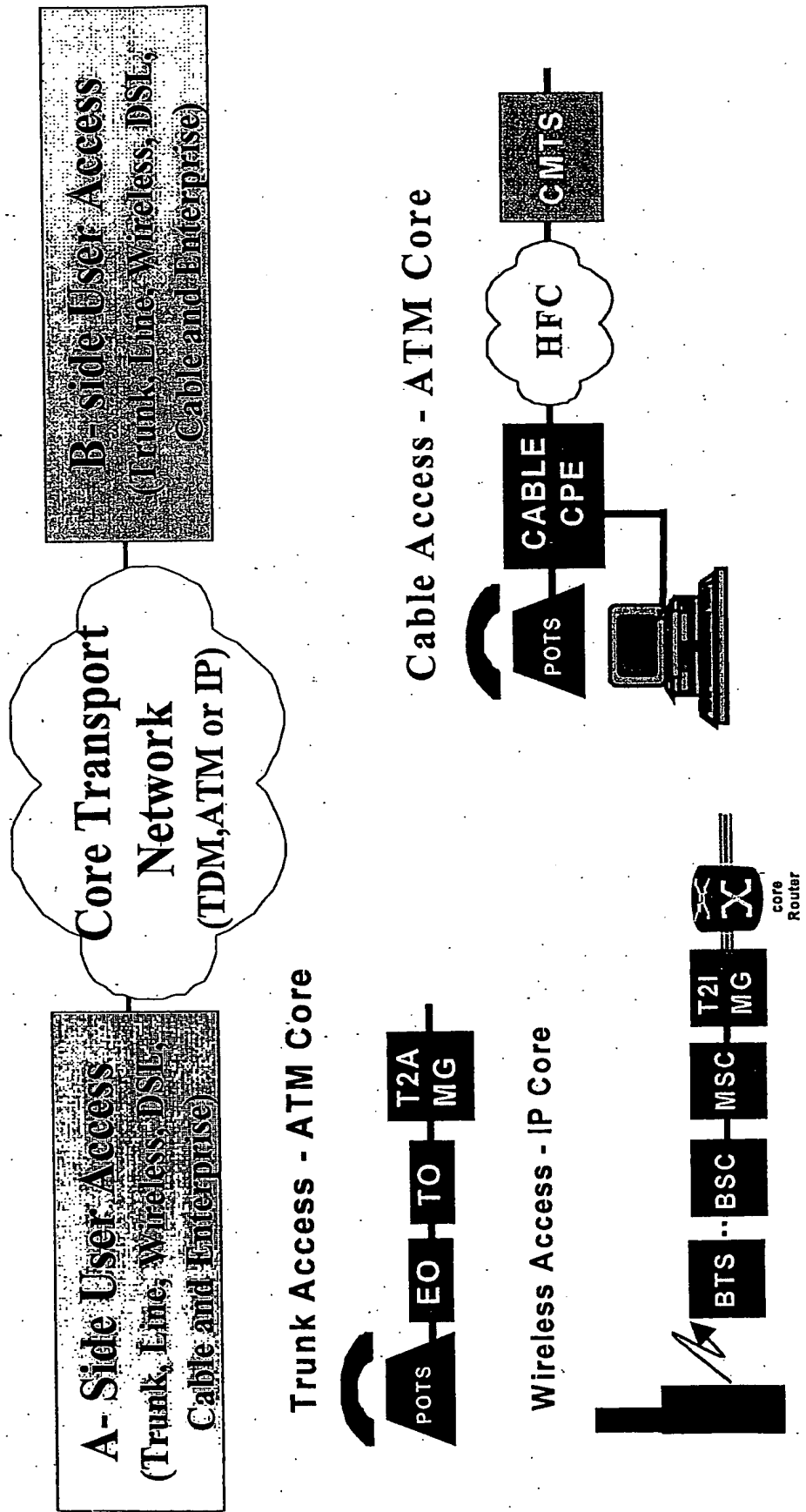


Fig. 41

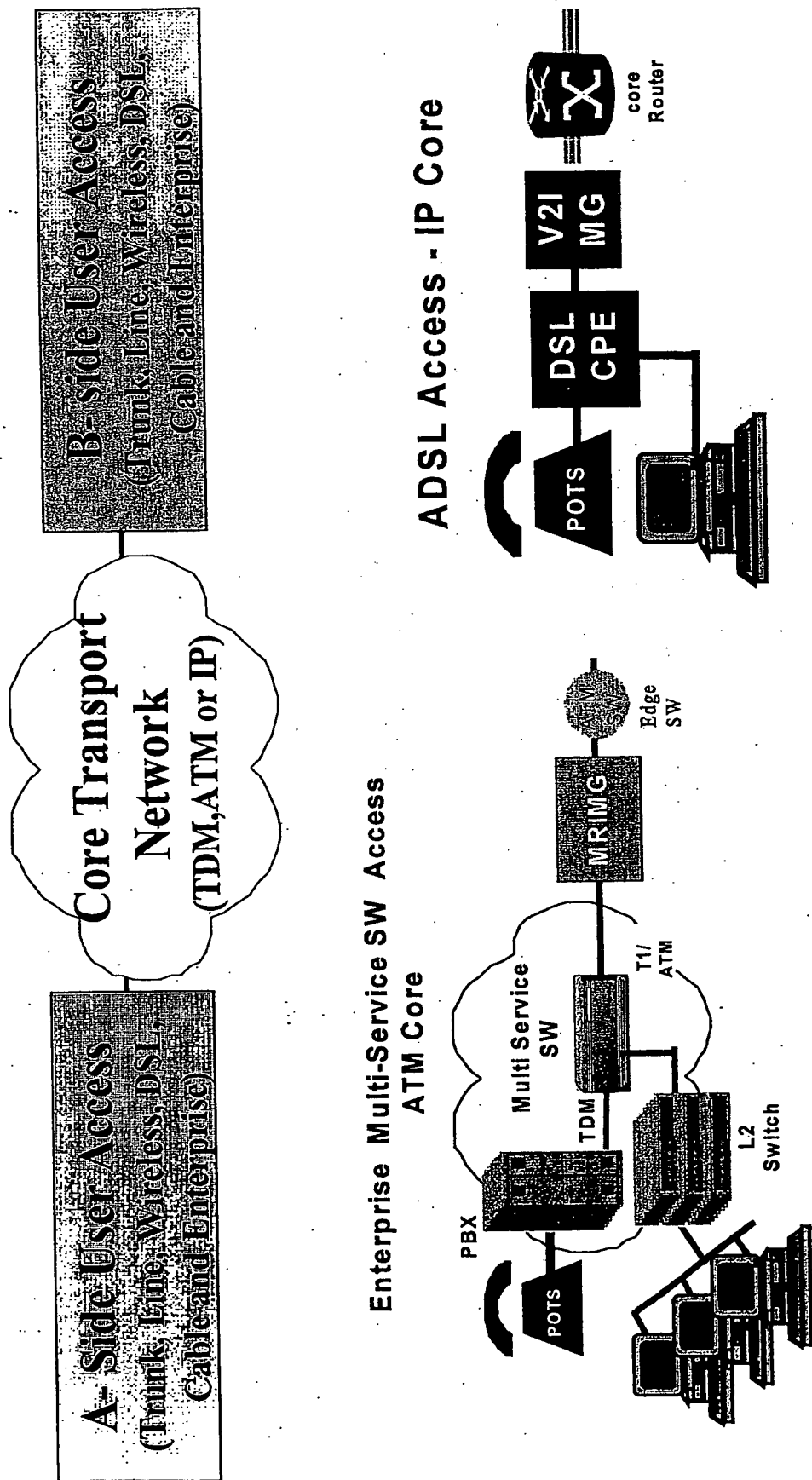


Fig. 42

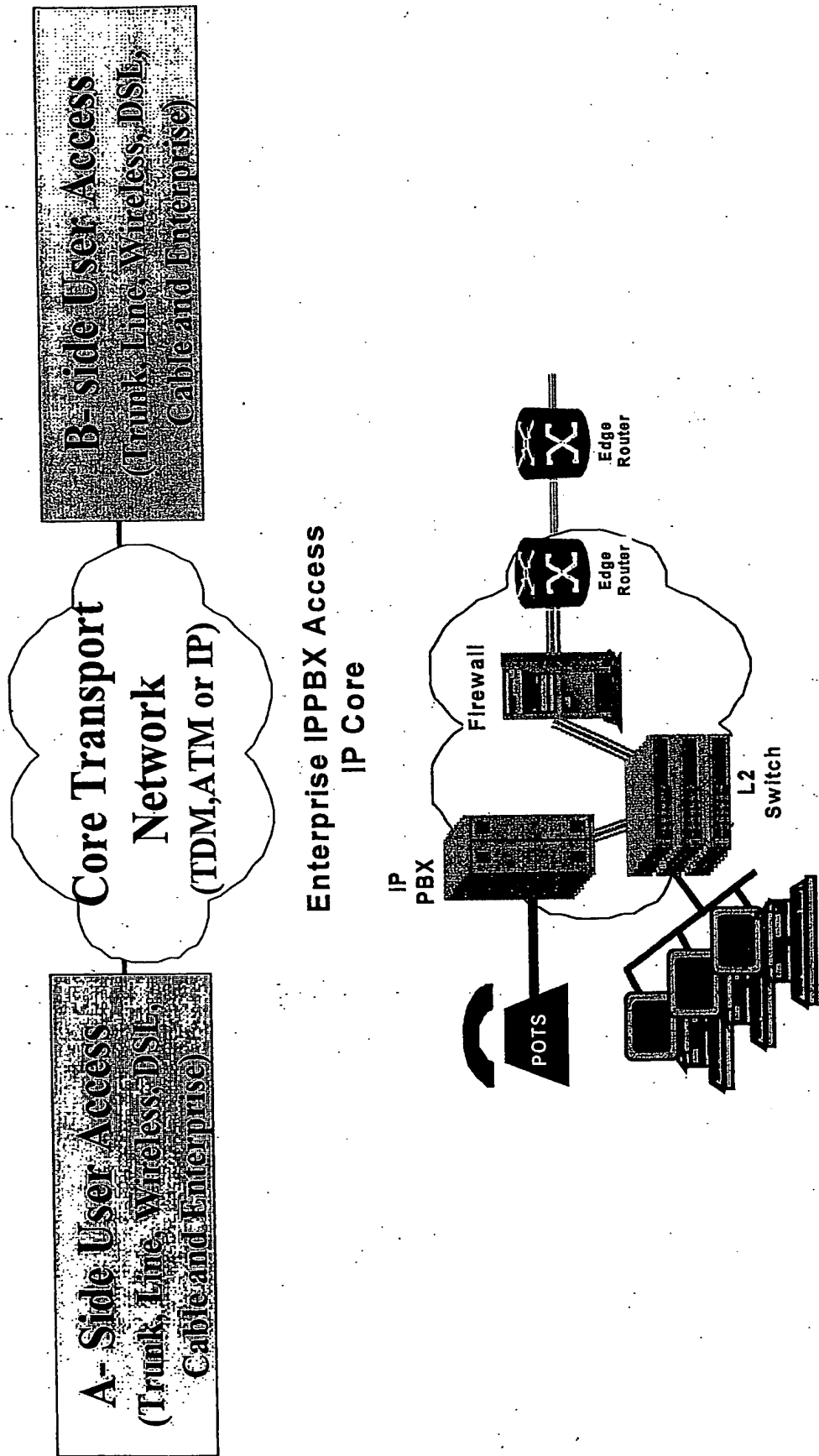


Fig. 43

Which impairments are being considered in the models?

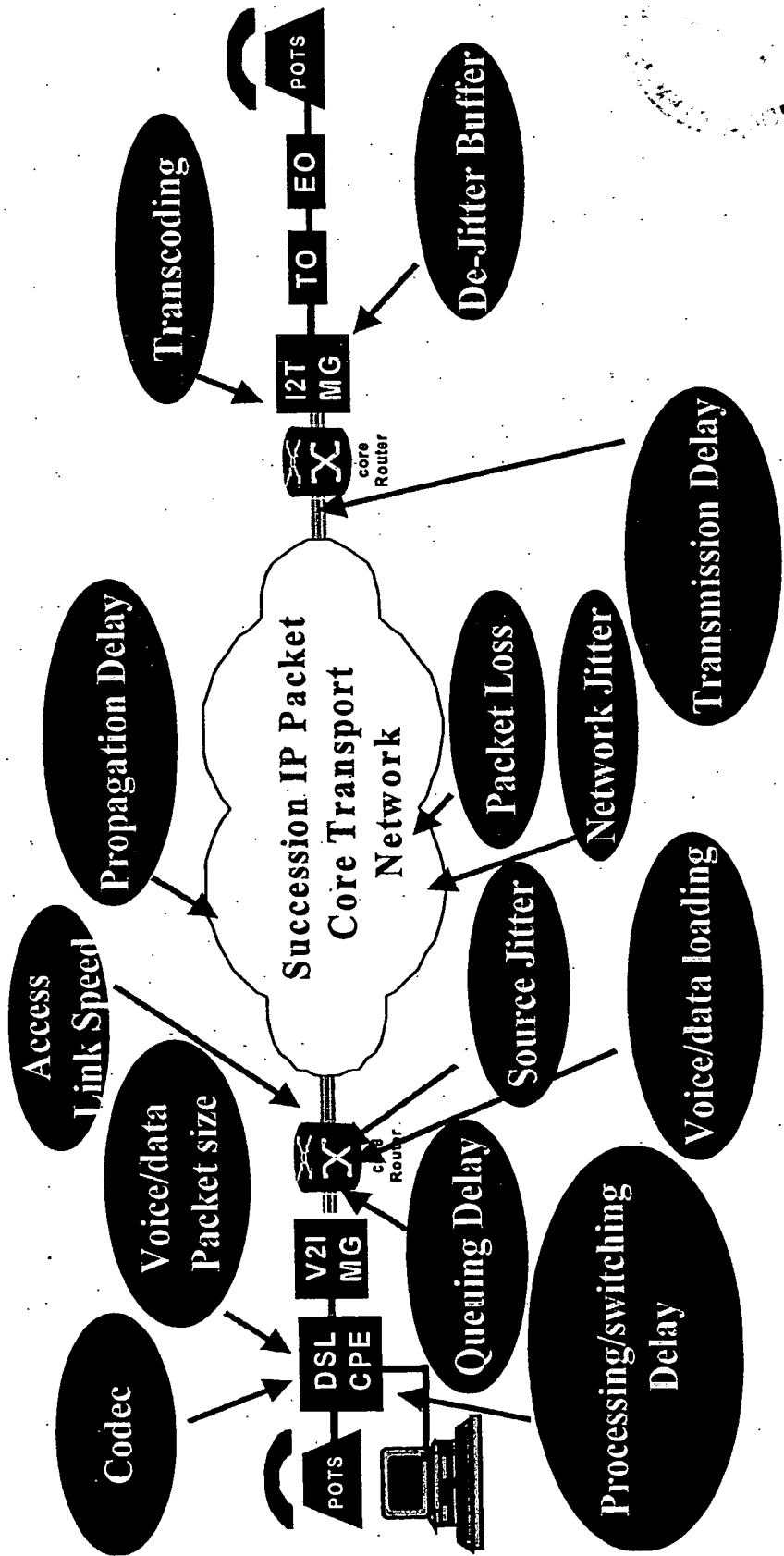
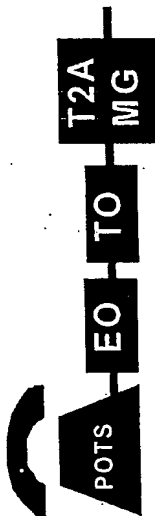


Fig. 44

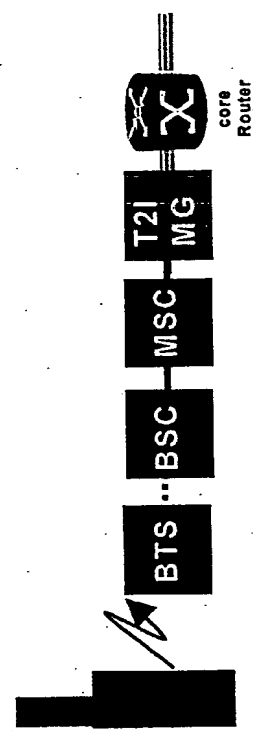
Trunk Access - ATM Core



Trunk Access to ATM Core - Delay Loss and Impairment Summary (All Delay Losses are in milliseconds)	
Set delay (Side A) (ms)	0
End Office Delay (Side A) (ms)	1.5
Tandem Office Delay (Side A) (ms)	0.75
T2AMG delay (Side A) (ms)	0.5
Trunk Access delay (ms)	2.75
Impairment Factor (Ie)	0

Fig. 45

Wireless Access - IP Core



	Uplink	Downlink
Mobile Switching Center (MSC) (ms)	1	2
Base Station Controller (BSC) (ms)	2.5	40
Base Station (BTS) (ms)	15.8	40.8
Mobile Set (MS) (ms)	72.1	14.3
T2AMG delay (Side A) (ms)	0.5	0.5
Wireless Access delay (ms)	91.40	97.10
Impairment Factor (Ie)	5	5

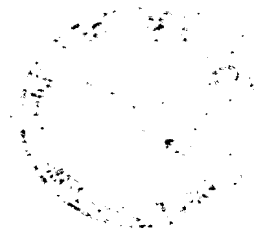
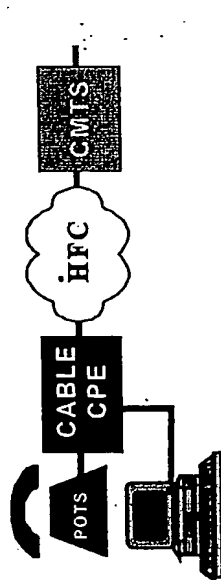


Fig. 46

Cable Access - ATM Core



Cable CPE		Cable CPE		Note
		Upstream	Downstream	
Link Speed		510 Kbps	3000 Kbps	note [1]
Voice packet size (byte)		160	160	note [2]
Voice packet overhead (RTP/UDP/IP)		48	48	
Data packet size (byte)		512	512	
Data packet overhead		48	48	
Voice packet link utilization (%)		10.0%	10.0%	
Data packet link utilization (%)		90.0%	90.0%	
Fixed Delay				
- Serialization delay for voice packet (ms)		3.26	0.55	note [3]
- DSP & CPU processing delay (ms)		12.00	14.00	note [4]
- Packetization Delay (ms)		0.00	N/A	note [5]
Variable Delay				
- Average Voice data contention (ms)		4.57	0.78	note [6]
- Maximum Voice data contention (ms)		9.15	1.55	note [6]
- De-Jitter buffer delay (ms)		N/A	0.00	note [5]
Other Impairments				
- Packet Loss (%)		0.00	0.00	note [5]
Minimum Delay (Fixed Delays) (ms)		15.26	14.55	
Average Delay (Fixed+Average Delays) (ms)	Variable	19.84	15.33	
Maximum Delay (Fixed+ Max Delays) (ms)	Variable	24.41	16.11	

Fig. 48

Terrestrial Distance (km)	8000 km (HP)	8000 km (ATV)	8000 km (EDM)	Note
Terrestrial propagation Delay @ 5us / km (ms)	40	40	40	From G.114
Submarine Distance (km)	-	-	-	
Submarine propagation Delay @ 6us / km (ms)	-	-	-	From G.114
Number of hop	5	8	4	From I.356, TIA IS-810 G.114
Equipment processing time (ms)	1ms x 5	0.03ms x 8	0.75ms x 4	
Jitter (ms)	note [1]	1.5 note [3]	0	I.356 QoS class 1
Total Delay (ms)	45	41.74	43	Note [2]

Terrestrial Distance (km)	8000 km (HP)	8000 km (ATV)	8000 km (EDM)	Note
Terrestrial propagation Delay @ 5us / km (ms)	40	40	40	
Submarine Distance (km)	-	-	-	
Submarine propagation Delay @ 6us / km (ms)	-	-	-	
Number of hop	5	8	4	
Equipment processing time per hop	1ms x 5	0.03ms x 8	0.75ms x 4	
Equipment processing time (ms)	5	0.24	3	
Submarine Distance (km)	11500	11500	11500	
Submarine Delay @ 6us / km (ms)	69	69	69	
Jitter (ms)	note [1]	3	0	I.356 QoS class 1
Total Delay (ms)	164	149.57	158	Note [2]

Fig. 49

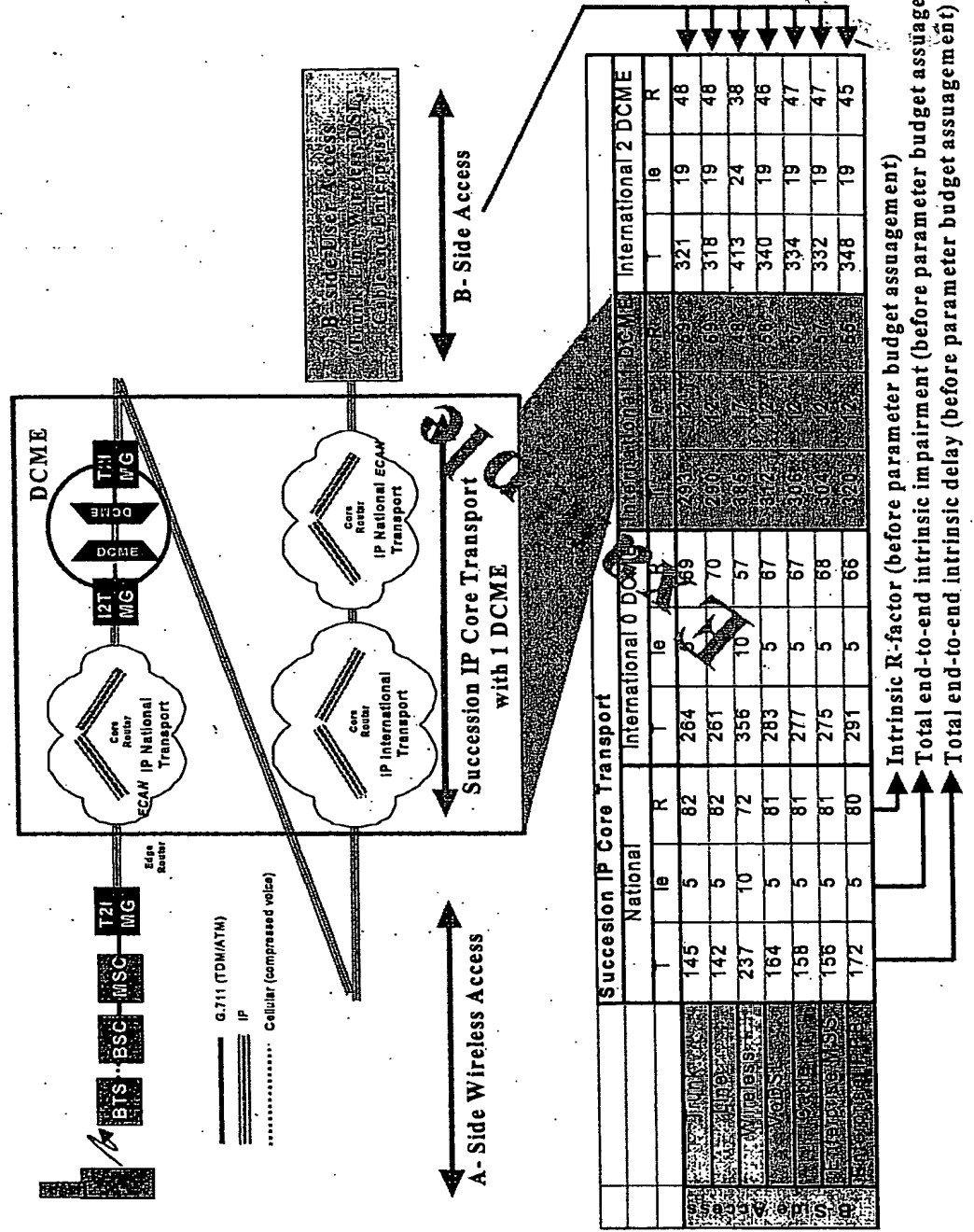


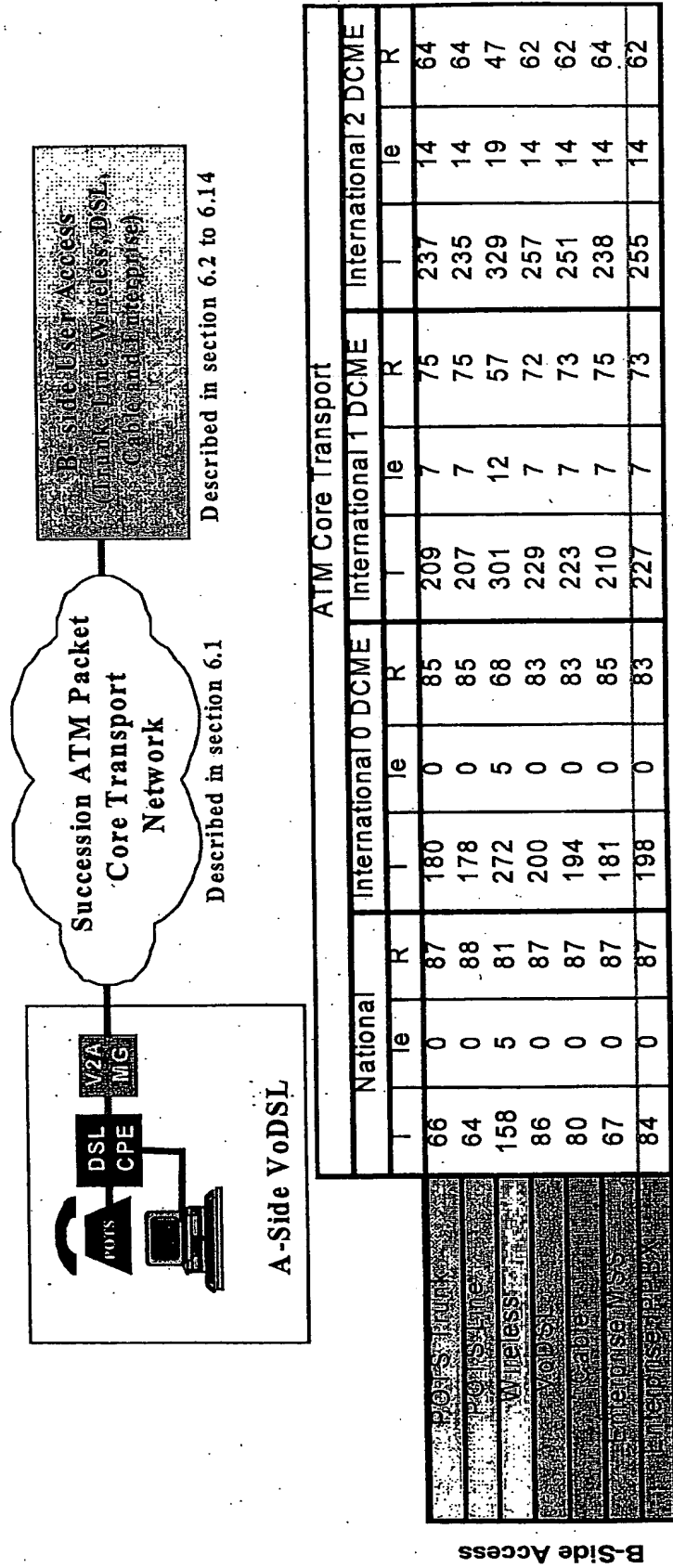
Fig. 50

	ATM Core Transport											
	National			International 0 DCME			International 1 DCME			International 2 DCME		
	I	le	R	I	le	R	I	le	R	I	le	R
Port Station	47	0	88	161	0	86	190	7	77	218	14	67
Port Line	45	0	88	159	0	86	188	7	77	216	14	67
Wireless	139	5	82	253	5	71	282	12	60	310	19	49
Wireless	66	0	87	180	0	85	209	7	75	237	14	64
Port Station	61	0	88	175	0	85	204	7	75	232	14	65
Port Line	48	0	88	162	0	86	191	7	77	219	14	67
Wireless	64	0	88	178	0	85	207	7	75	235	14	64

B-Side Access

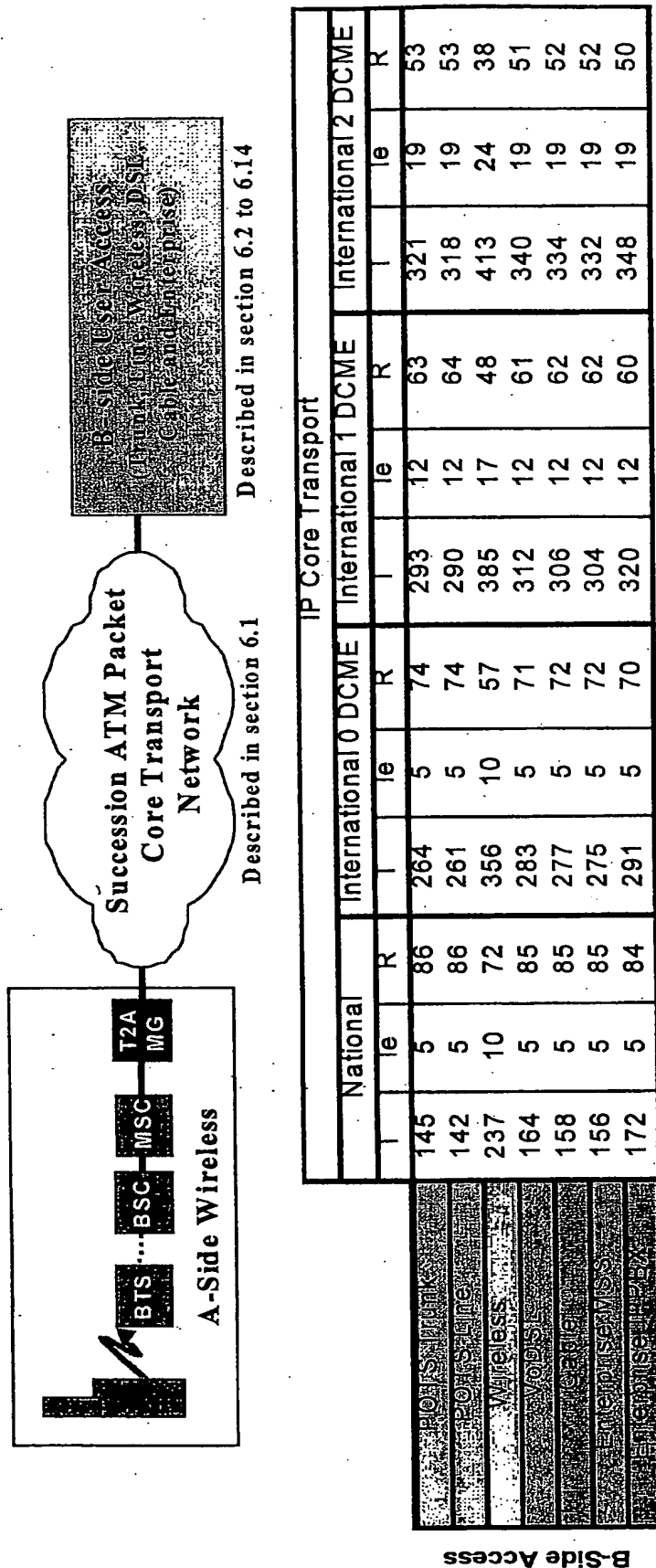
Note: The four parameters: packetization delay, delay jitter, codec and packet loss have been set to zero. Those four parameters will be determined based upon the available margin. The margin is determined based on the benchmark comparison of an end-to-end Succession network with the closest benchmark representation of existing networks (PSTN only, mobile to PSTN, or mobile to mobile).

Fig. 51



Note: The four parameters: packetization delay, delay jitter, codec and packet loss have been set to zero. Those four parameters will be determined based upon the available margin. The margin is determined based on the benchmark comparison of an end-to-end Succession network with the closest benchmark representation of existing networks (PSTN only, mobile to PSTN, or mobile to mobile).

Fig. 52



Note: The four parameters: packetization delay, delay jitter, codec and packet loss have been set to zero. Those four parameters will be determined based upon the available margin. The margin is determined based on the benchmark comparison of an end-to-end Succession network with the closest benchmark representation of existing networks (PSTN only, mobile to PSTN, or mobile to mobile).

Fig. 53

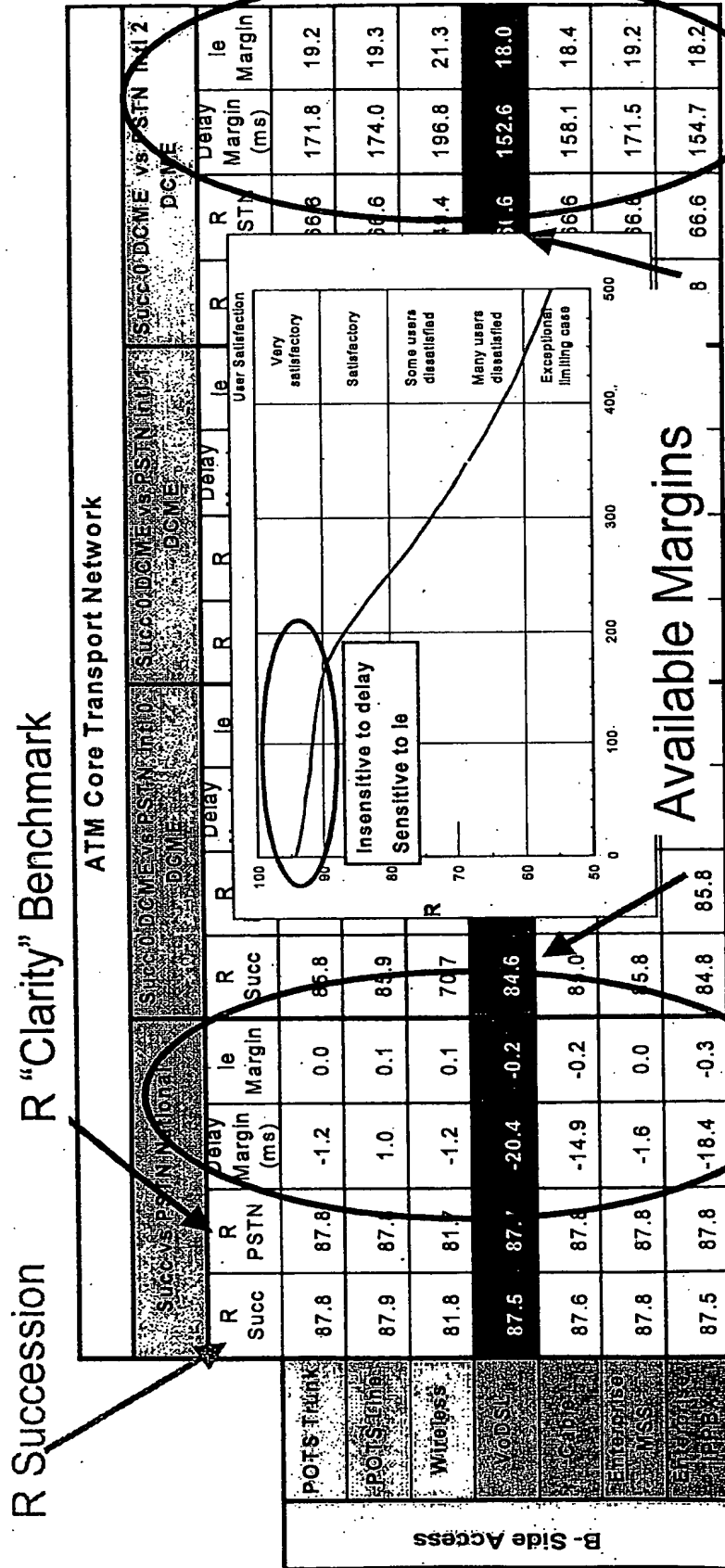
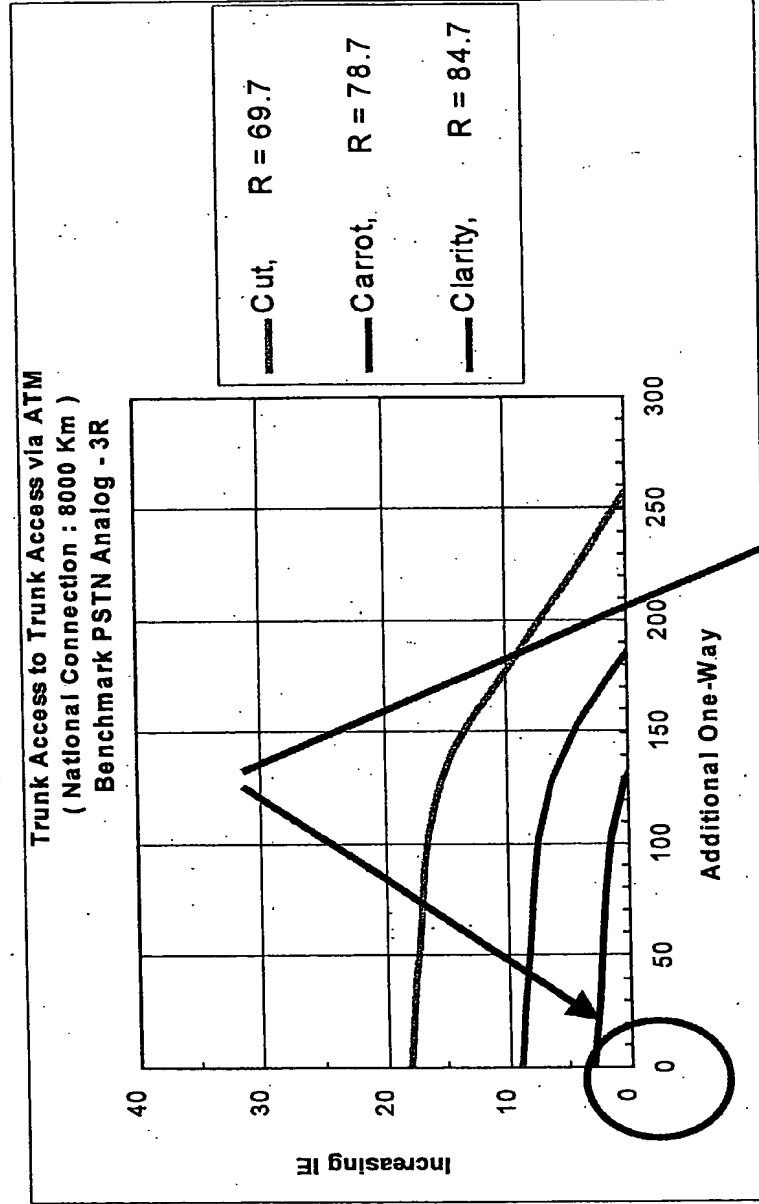
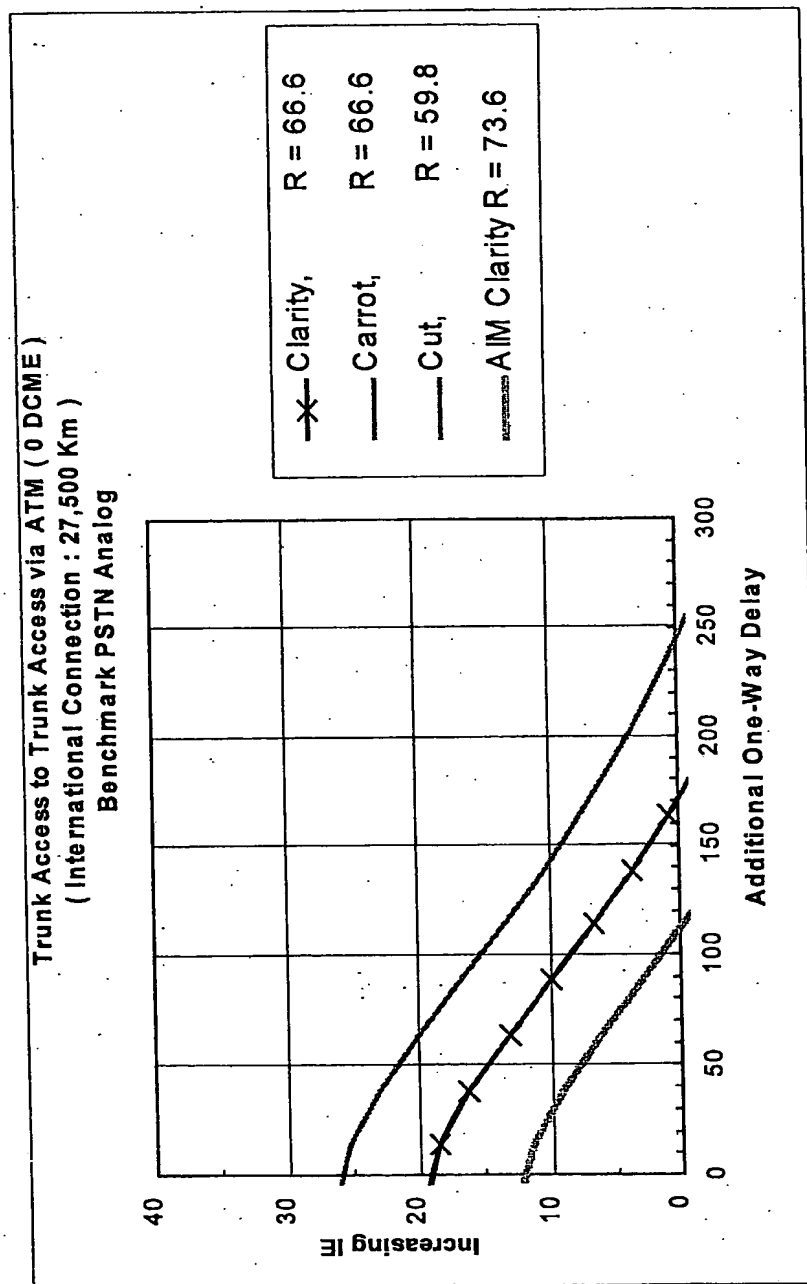


Fig. 54



le Budget =	3	9	18
Delay Budget =	130	186	257

Fig. 55



Ile Budget =	12.07	19.07	19.07	25.87
Delay Budge	110.9	171.5	171.5	244.4

Fig. 56

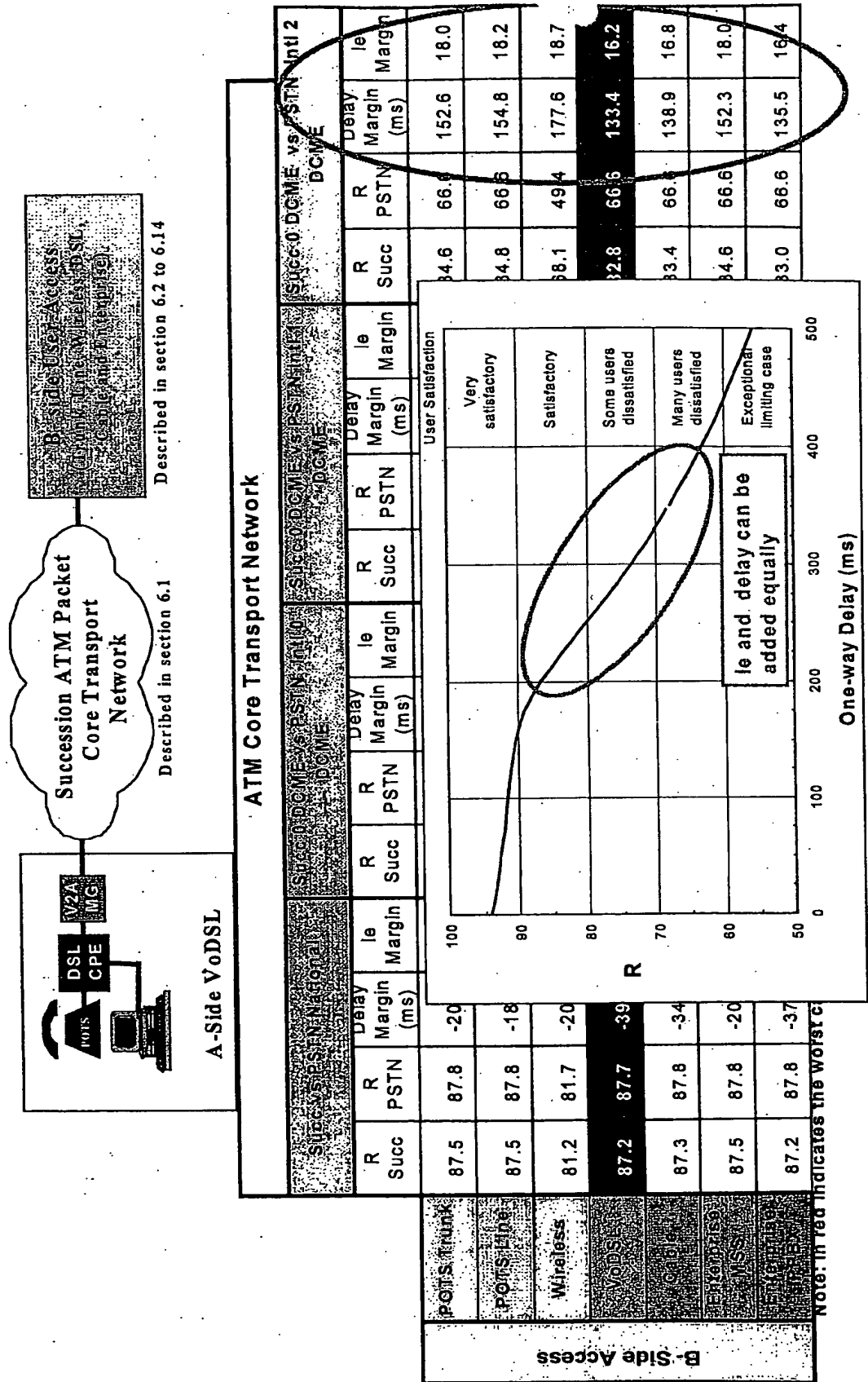
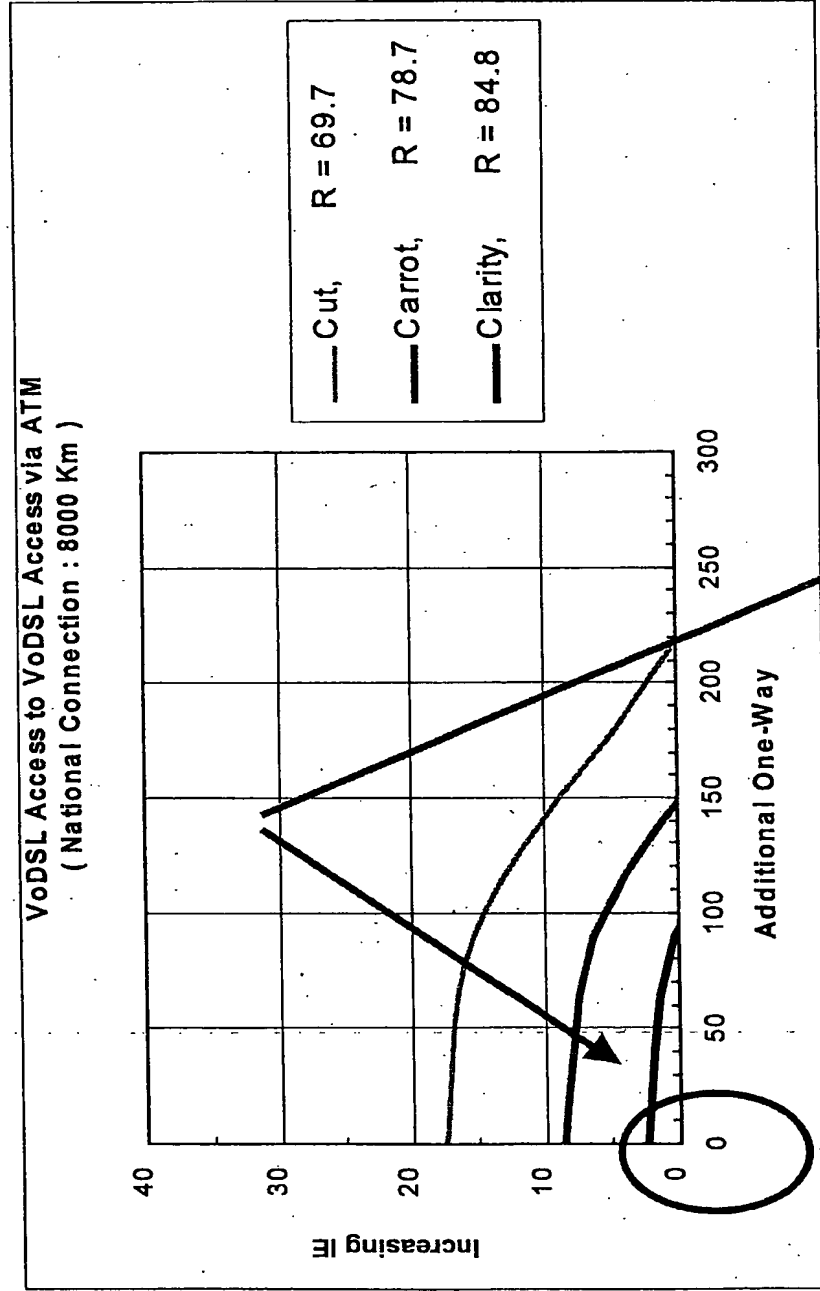
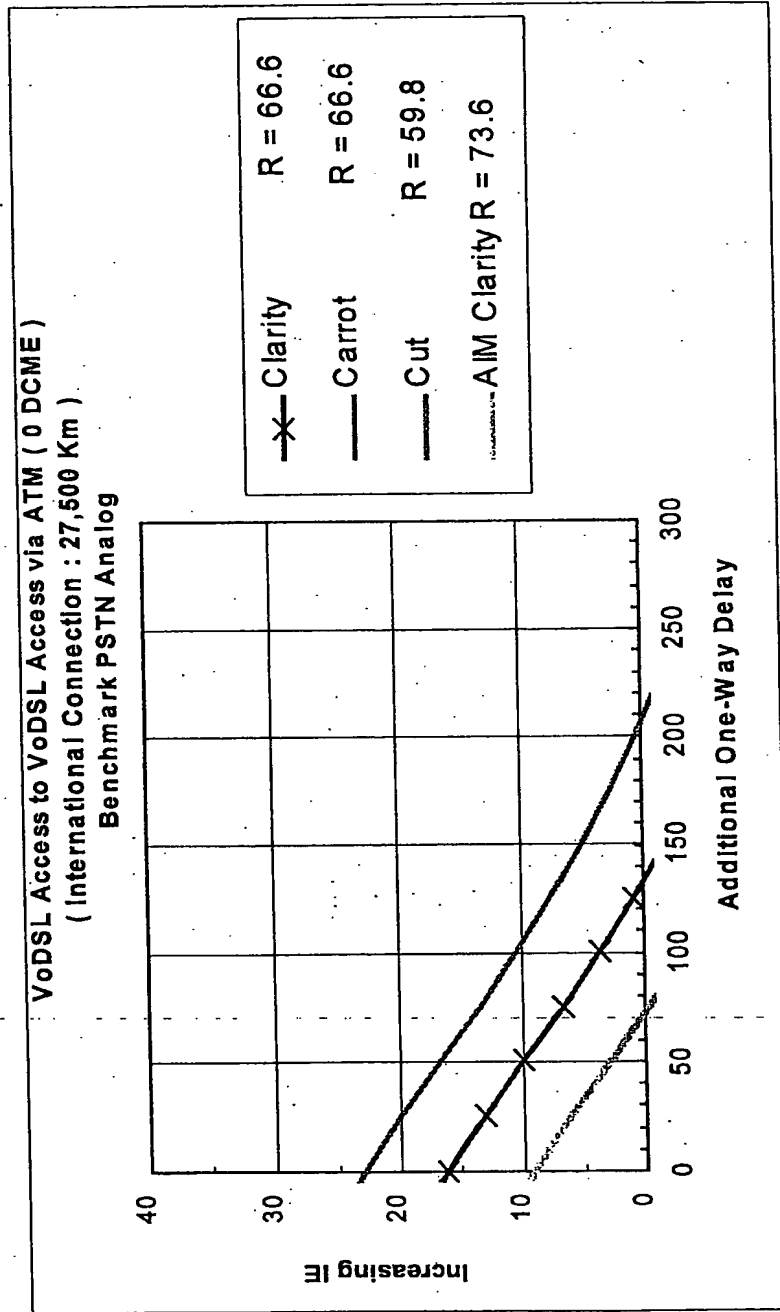


Fig. 57



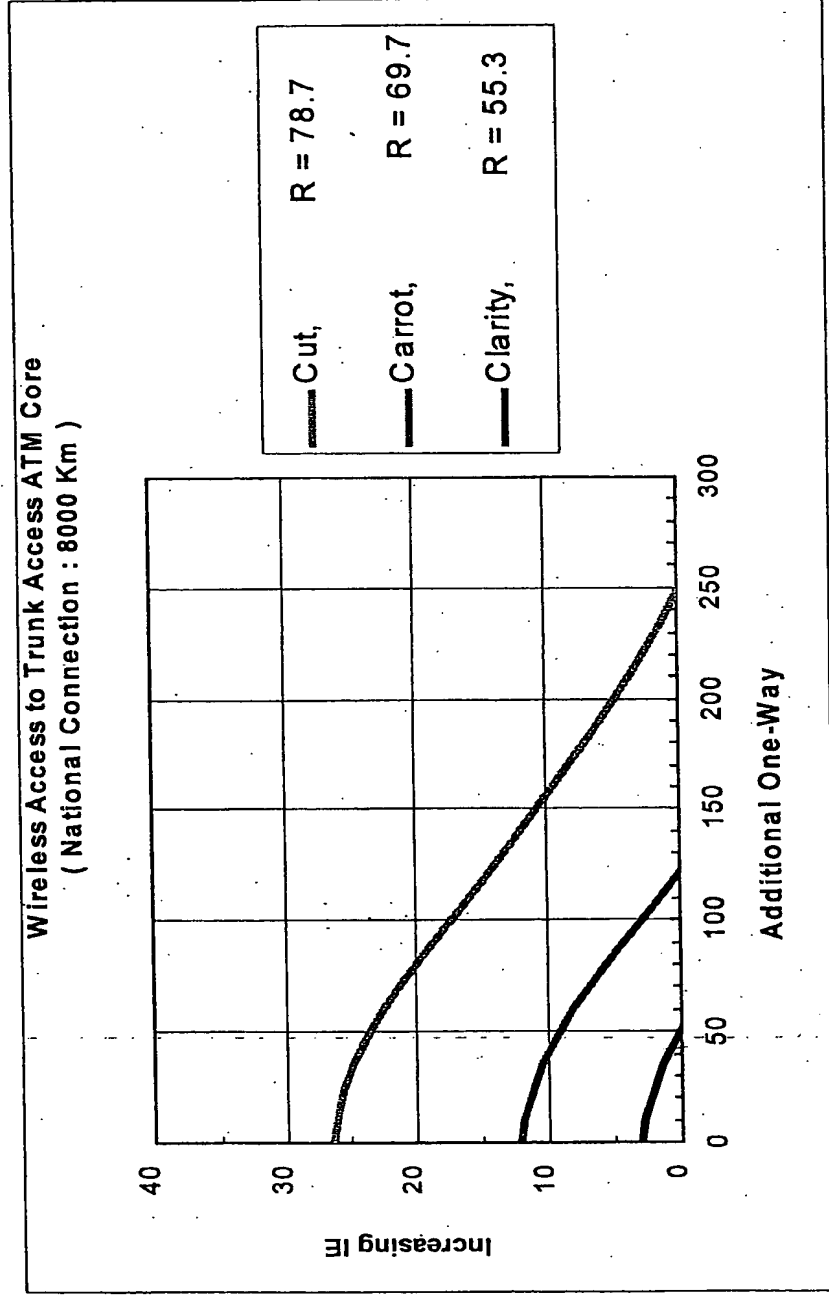
le Budget =		2	8	17
Delay Budget =		92	147	219

Fig. 58



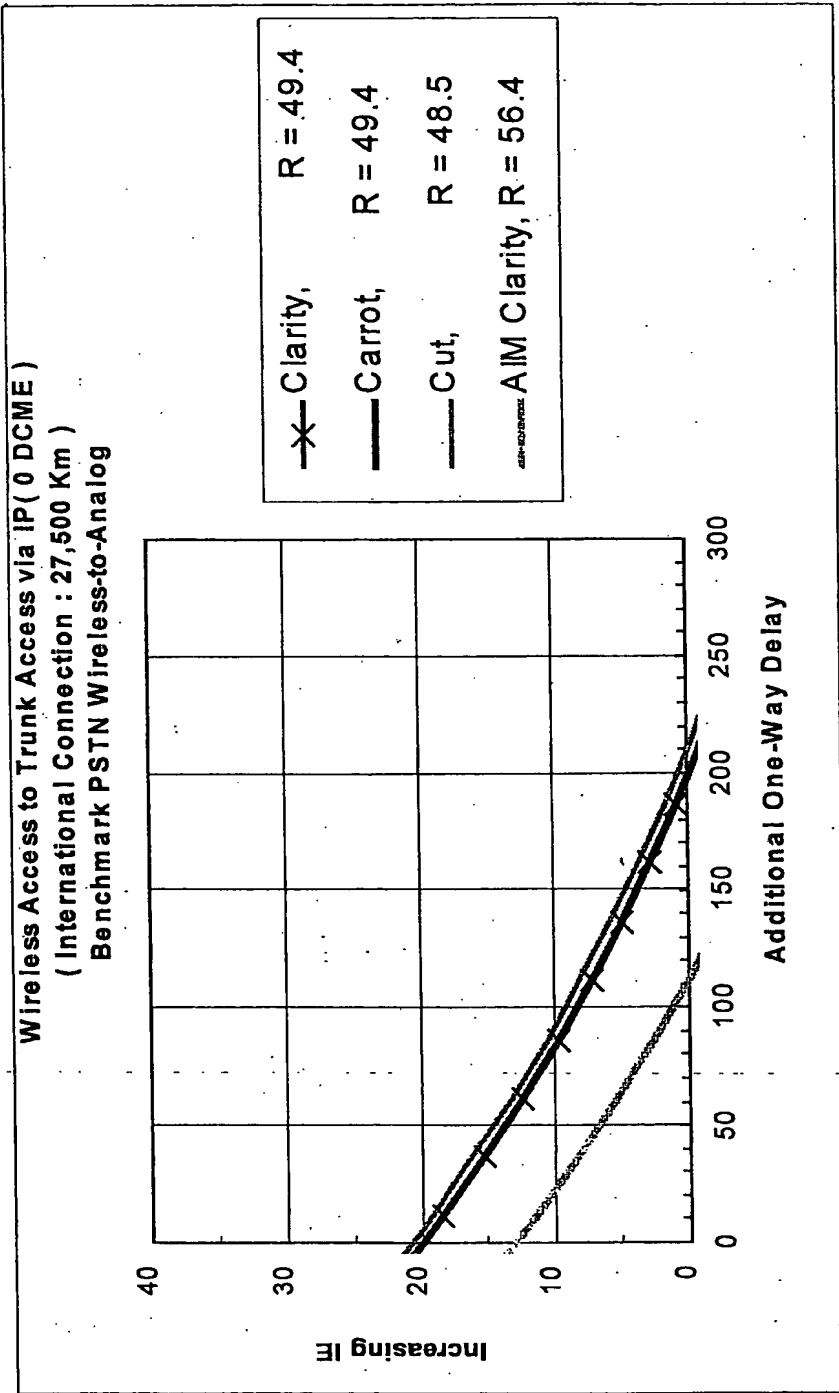
le Budget =	9.207	16.21	16.21	23.01
Delay Budget =	72.54	133.1	133.1	206

Fig. 60



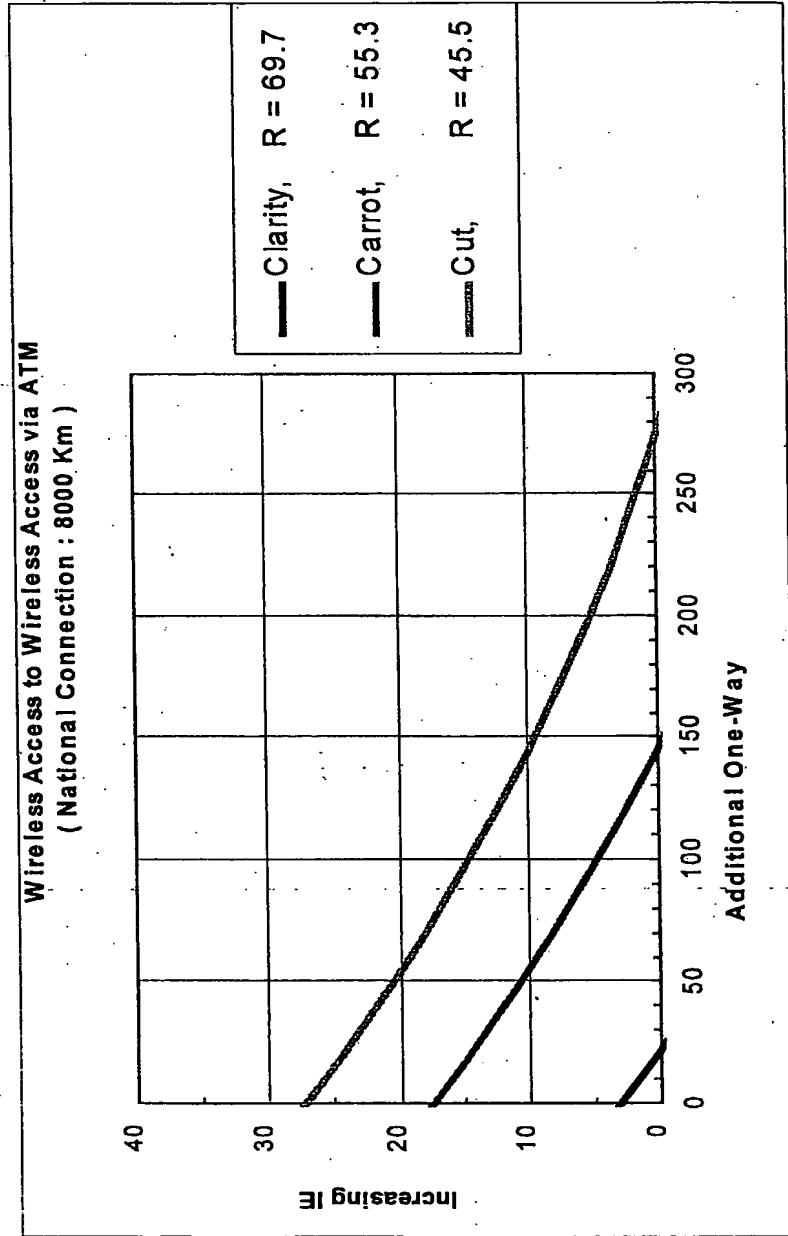
le Budget =	3	12	26
Delay Budget =	51	121	249

Fig. 61



le Budget =	12.91	20	20	21
Delay Budget =	112.4	197	197	210

Fig. 62



Delay Budget =	3.004	17.34	27.14
le Budget =	21.97	145.8	273.1



le Budget =	2	12	19	19	19
Delay Budget =	25	151	181	248	289

Fig. 64

Rank	Codec	E-model Impairment Factor (Ie)	Estimated im plementation delay (ms)	Note
1	G.711 at 64 kb/s	0	0.125	PCM
2	G.726 at 32 kb/s with Synch Coding	7	0.250	ADPCM
3	GSM-EFR	5	40	GSM
4	IS-733	*	40	
5	G.728 at 16 kb/s	7	1.250	
6	G.729/G.729A at 8 kb/s	10/11	25	
7	IS-641	6	40	TDMA
8	G.723.1 at 6.3 kb/s (not recommended)	15	30	Soft Phone

Fig. 65

Codec		packetization delay (ms)	max packet loss (%)	le due to packet loss
type	Codec le			
G.711	0	10	0%	0
G.711	0	20	0%	0
G.726(1)	7	10	0%	0

1. This codec is only really suitable for international

Fig. 66

Codec		packetization delay (ms)	max packet loss (%)	le due to packet loss
type	Codec le			
G.711	0	10	0%	0
G.711	0	20	0%	0
G.711	0	40	0%	0
G.726	7	10	0%	0
G.726	7	20	0%	0
G.726	7	40	0%	0
G.711	0	10	1%	5
G.711	0	20	1%	5

Fig. 67

Codec		packetization delay (ms)	max packet loss (%)	le due to packet loss
type	Codec le			
G.711	0	10	0%	0
G.711	0	20	0%	0
G.711	0	40	0%	0
G.726	7	10	0%	0
G.726	7	20	0%	0
G.726	7	40	0%	0
G.729	11	10	0%	0
G.729	11	20	0%	0
G.729	11	40	0%	0
G.711	0	10	1%	5
G.711	0	20	1%	5
G.711	0	40	1%	5
G.726	7	10	1%	2
G.726	7	20	1%	4
G.726	7	40	1%	8
G.729	11	10	1%	2
G.729	11	20	1%	4

Fig. 68

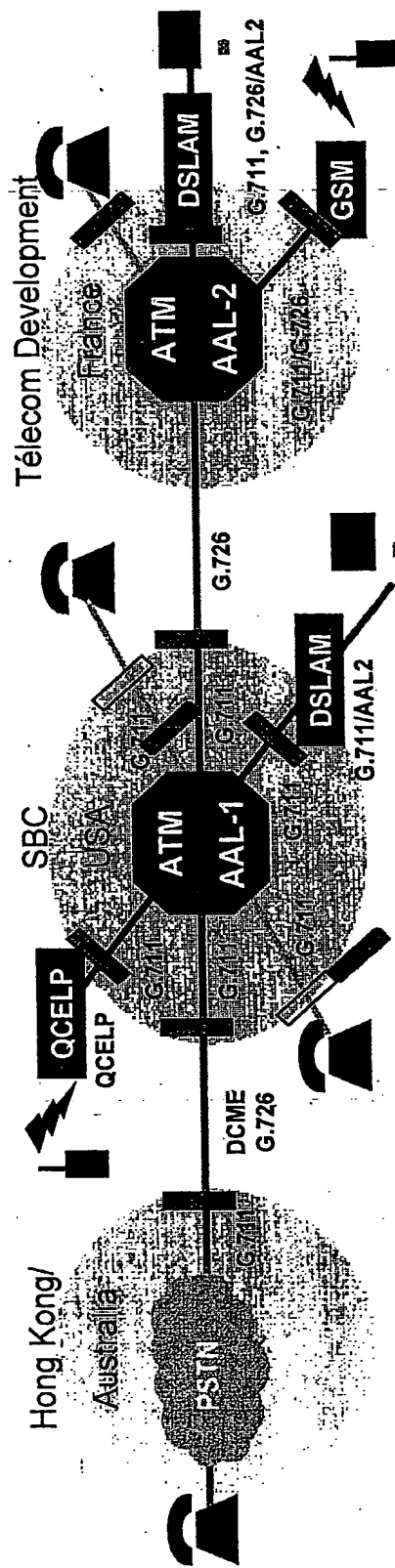


Fig. 69

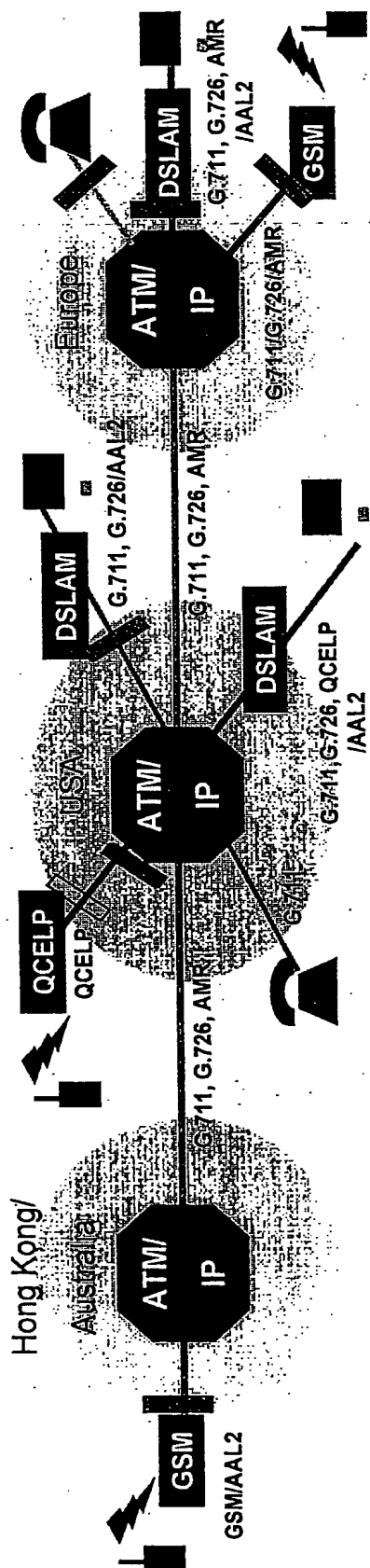


Fig. 71

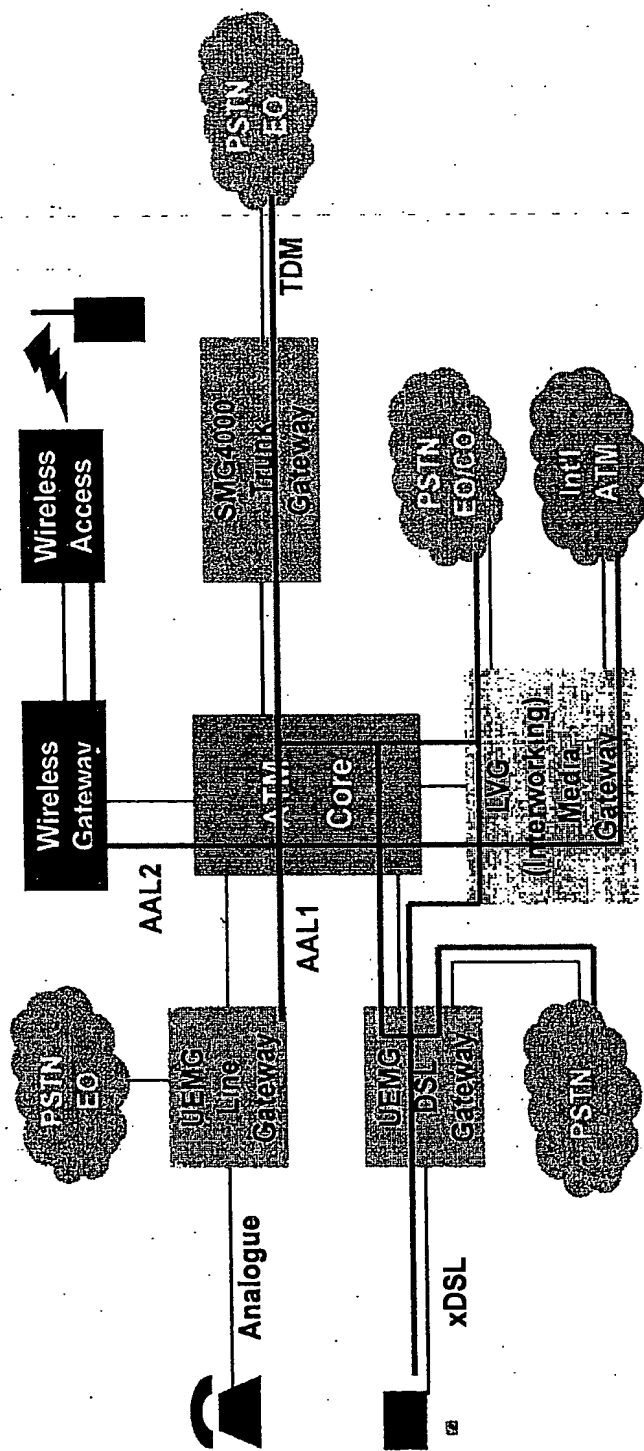
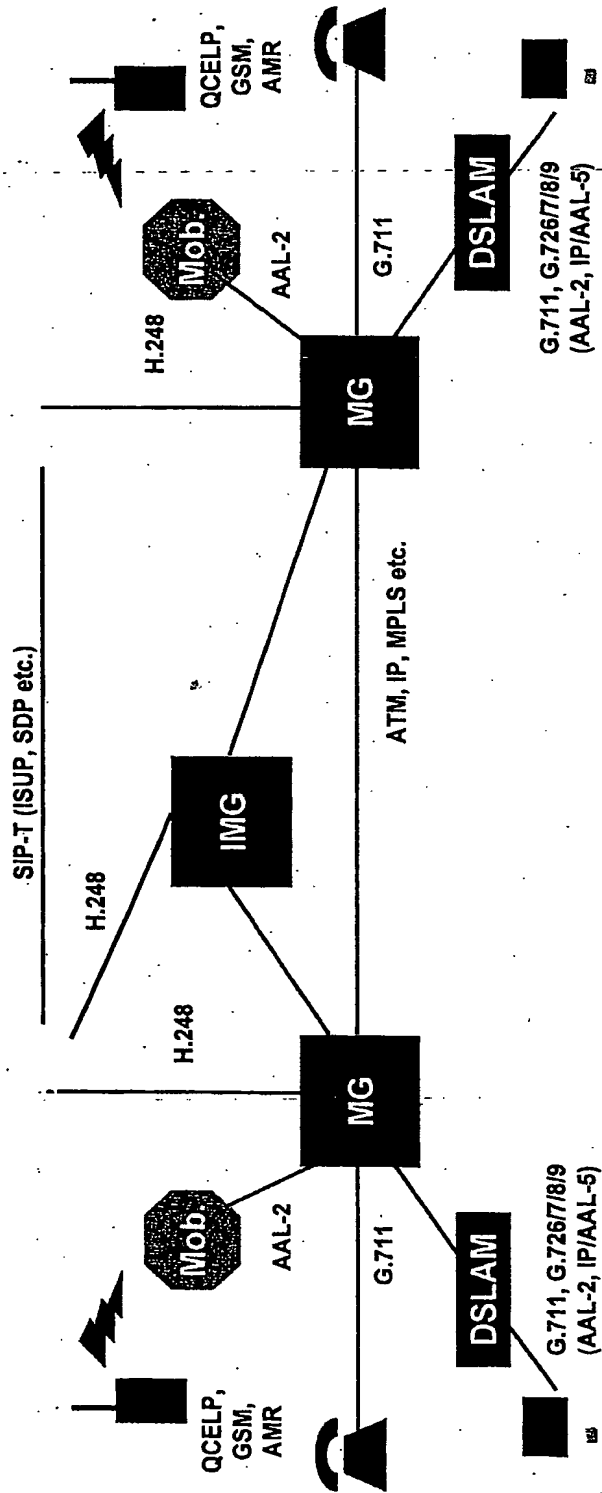


Fig. 72



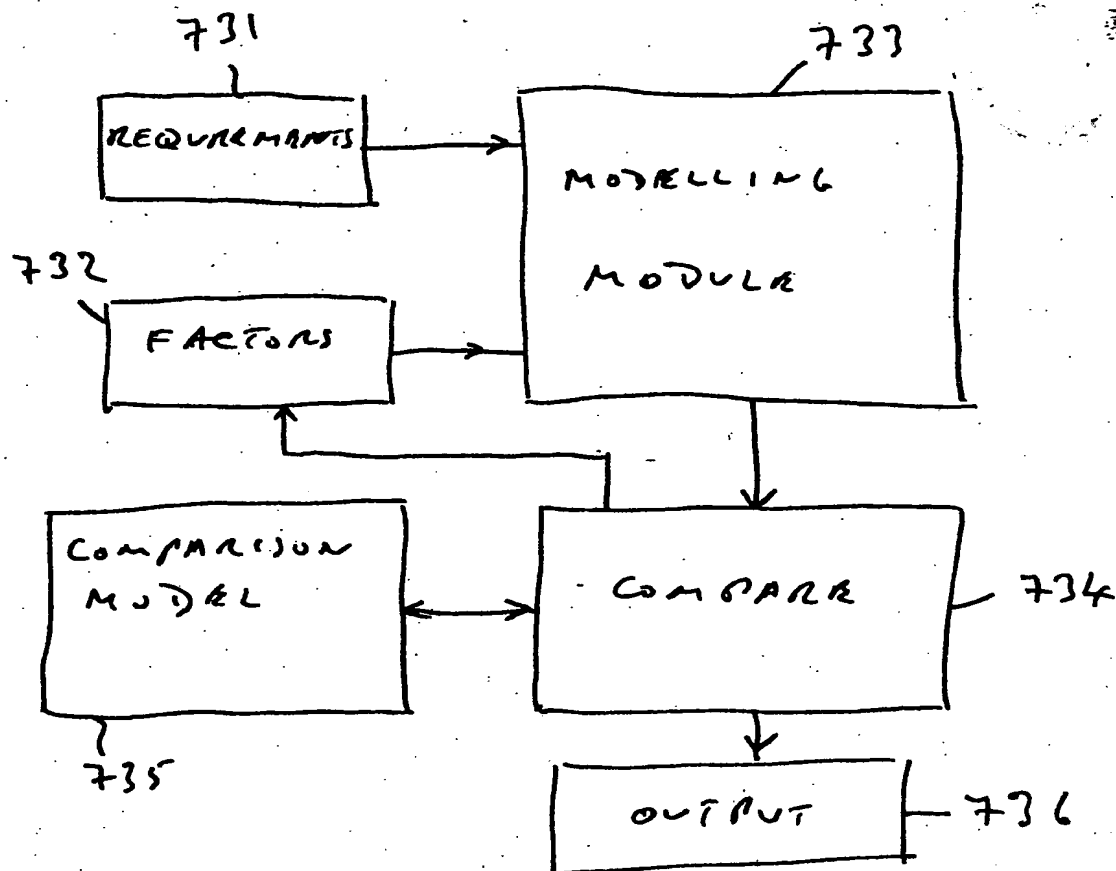


Fig 73